

This Issue Features:

- Quality Crimp Standards
- Aluminum Wire - The New Lightweight
- Vehicle Harness Design Tools Model the Real World
- Thermoplastic vs. Thermoset Wire and Cable Materials
- Surplus and Used Machinery, Parts, and Employment Opportunities



YnZ's Yesterday's Parts

By Fred Noer

When the best-selling book *Do What You Love, the Money Will Follow* was being written, author Marsha Sinetar would have done well to interview Gene Zdunowski to tell his story about his wiring harness business called YnZ's Yesterday's Parts.

Zdunowski epitomizes Sinetar's message of encouraging people to do work they really enjoy. He takes great pleasure in his company making harnesses for

vehicles from the early 1900s to the mid-1970s that are being restored.

"I am a car nut who has been fortunate enough to put together a business that I can make my living from," Zdunowski said. "I love the car restoration hobby. It has given me a good life, and I have met so many wonderful people."

"With the business, I feel we are contributing to antique automobile history. The world has a love affair with the automobile, so there's a lot heritage to preserve," Zdunowski said. "We want to be there for the tens of thousands of



YnZ employee building a new harness for a 1946 Dodge 1/2 Ton pickup harness.

Aluminum Wire The New Lightweight

By Joe Tito
Wiring Harness News

We all recall vividly the summer of 2008, when we arrived at the gas pump horrified to see prices well over \$4.00 per gallon. Wire harness manufacturers reacted in much the same way when

copper prices soared over \$4.00 per pound. Randy Sumner, Innovation Manager for Wiring and Cable at Delphi Corporation, recalls both. That's when discussion ensued to analyze the removal of copper from automotive wiring systems where possible. The benefits would be twofold: Delphi could get commodity prices under control, and mass could be reduced. Mass reduction was part of the pressure being brought by auto manufacturers to improve overall fuel efficiency. With much lighter aluminum at around \$1.40 per pound, the two most suitable replacements for copper wire were aluminum and copper-clad aluminum. Delphi engineers began to study the use of both.

Copper-clad aluminum is a composite wire consisting of an aluminum core clad with ETP Copper, and is about 1/3 the weight of regular copper. Even though the material is 90% aluminum, the wire has high frequency electrical properties similar to solid copper. At first, Sumner indicated, copper-clad aluminum seemed the most logical replace-

ment for copper wire. However, hobbyists and provide a service that they couldn't get anywhere else."

Zdunowski is restoring his 13th car - a 1968 Jaguar E-Type. His first restoration was a 1911 Stanley Steamer, and in between have been four Chevrolets, three Porsches, 1929 Hudson, 1949 Cadillac and 1954 Bentley.

The business, which Zdunowski, 63, owns and operates with his wife Donna

in Redlands, Calif., in the Los Angeles metropolitan area, was started in 1969 after he exhibited his 1928 Chevrolet at an Antique Automobile Club of America show. A judge, who was impressed by the wiring harness in Zdunowski's car, wanted a harness made for his vehicle.

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Crimp Quality Standards Comparison and Trends

By Rob Boyd
Crimping Product Manager
Schleuniger Inc.

Quality standards are getting tougher each year. In these difficult times, wire harness manufacturers are looking to expand business in their existing markets and are looking for new markets. The following article will compare and contrast the current quality standards that are most commonly used today. I will review proper measurement techniques, discuss some trends in crimp quality, and address methods to improve efficiency in quality data collection.

It goes without saying that manufac-

turing companies want top notch quality at the lowest possible price. All too often, they demand higher quality at the same or lower price. There are so many standards to adhere to and each manufacturer might have different requirements. Not only do we need to keep track of the numerous standards in the US but now that US companies are bidding for European jobs, we need to understand the European standards as well. Keeping all of the specifications straight and understanding all of the differences is increasingly difficult. We've also experienced situations where manufacturing companies had differences of opinion on what their own internal stan-

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Delphi Aluminum Cable

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Contributing to antique automobile history by providing harnesses for vehicles from the early 1900s to the mid-1970s.

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Crimp Quality Standards Comparison and Trends

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Vehicle Harness Design Tools Model the Real World

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Tyco Electronics Announces Winner of its Premium 500 Piece Poker Set



At the recent Wire Processing Technology Expo in Milwaukee WI, Tyco Electronics Global Application Tooling Division promoted a drawing, for a Premium 500 Poker Set. All attendees who signed up for our e-blast were entered in the drawing and were eligible to win.

Following the show, a name was chosen at random from all entries and a name was drawn as the lucky winner.

This years winner of the Tyco Electronics Premium 500 Piece Poker Set is Timothy King, of King Associates Ltd, located Lancaster PA. Congratulations Timothy and enjoy your poker set.

In addition we want to thank everyone who visited our booth and for supporting Tyco Electronics Global Application Tooling Division.

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Realizing Dreams

By Paul Hogendoorn

There is a simple formula for realizing your dreams – for making dreams come true. While some people seem to have the Midas touch, others seem stuck in perpetual dream land. It's true that sometimes the difference may be timing or luck, but more often than not, the difference is within the control of the dreamer. It's a matter of formula.

Here's my formula for converting dreams to realities:

Dreams + Imagination = Possibilities

Possibilities + Determination = Probability

Probability + Planning = Realization

It's a formula I have followed nearly my whole life – in business and with personal objectives as well. Everything starts with dreams.

It doesn't matter what company you are working for right now – a big one, a small one, a new one, or an old one, your own or somebody else's – at some point, it was just somebody's dream that was converted into a reality. Most companies continue to identify their dreams to keep all the stakeholders on the same page; it's called "their vision".



Paul Hogendoorn,
President OES, Inc.

Possibilities, or better put, opportunities, are every company's biggest asset. No opportunities means no future. Opportunities are what you need when facing life threatening challenges, or when looking to grow the company beyond normal organic growth. When things are going well and the order books are full, the tendency is to keep focusing on what's working well. But when the order book starts to shrink, and the future starts to look a little dim-

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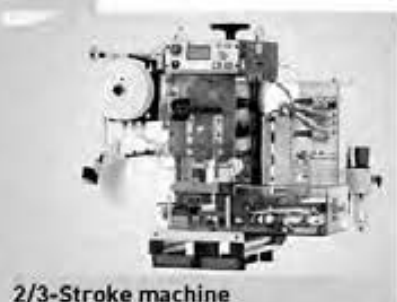
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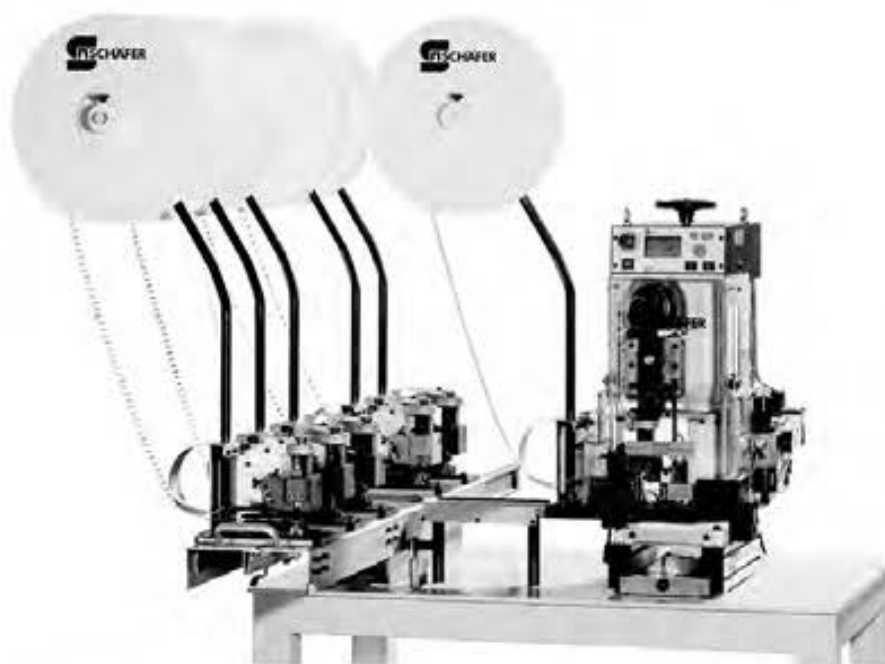
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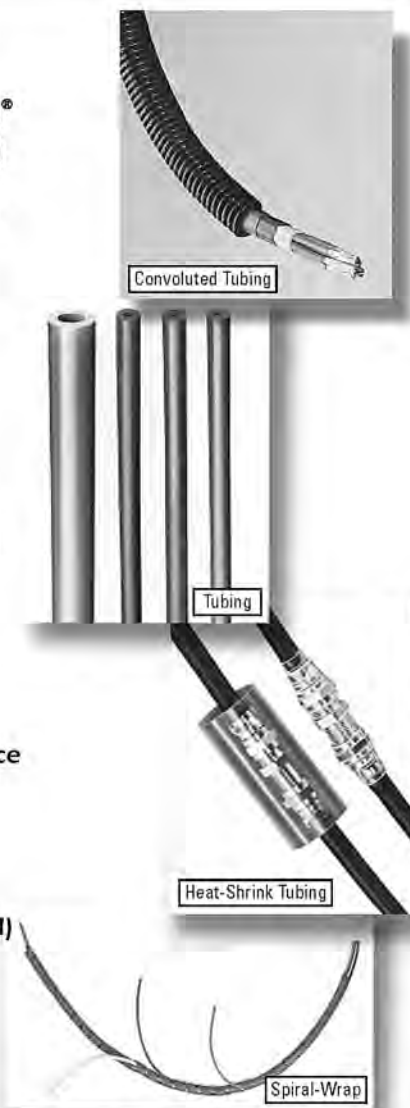
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Realizing Dreams

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mer, that's when the company needs to draw from a healthy inventory of possibilities. Possibilities are created by applying imagination to the vision.

Converting a possibility into a probability takes a determined and tenacious effort. Some might think that planning is the next big step, but no, it's determination. Nearly every new idea is met with resistance, skepticism, doubt and sometimes even opposition. All the planning in the world can't plan away those things. When it's a new idea that no one else has thought of before, one common reaction is that if it was such a good idea, somebody would have already done it. Another reaction often is that it can't be done for the simple reason that nobody has found a way to do it. Some form of proof or base level of performance is needed, and that will take a determined effort. Think of it this way: if it was obvious and easy, others would already be doing it. Because they are not though, indicates that it was neither obvious, nor easy. Thomas Edison reportedly failed a thousand times before finally creating the light bulb. Determination is the main ingredient required to convert the possibility into a probability.

Planning is also important. Planning provides a roadmap that keeps you from covering the same ground again and

again, or from failing to stay the course and try out all the possibilities that you intended to. It provides an order and method from which to effectively apply your efforts. It is also the discipline that keeps you from blindly spending all of your resources, or from failing to convert your achievements into positive commercial gains. Because imagination and determination by themselves know no boundaries, good planning is needed to make sure you don't go broke pursuing a dream you don't achieve, or to make sure you profit properly from it if you do.

Of the four ingredients listed though, imagination and determination are the two most critical for companies today. The dreams are already captured by the company's vision, and effective planning skills are something that can be taught, learned, hired or acquired. But imagination and determination are the unquantifiable intangibles needed for success; they can't be measured, inventoried, mandated, bought or sold. And for imagination to be effective, it almost always requires determination. Imagination without determination seldom yields any positive results. Neither does sheer determination without any real imagination.

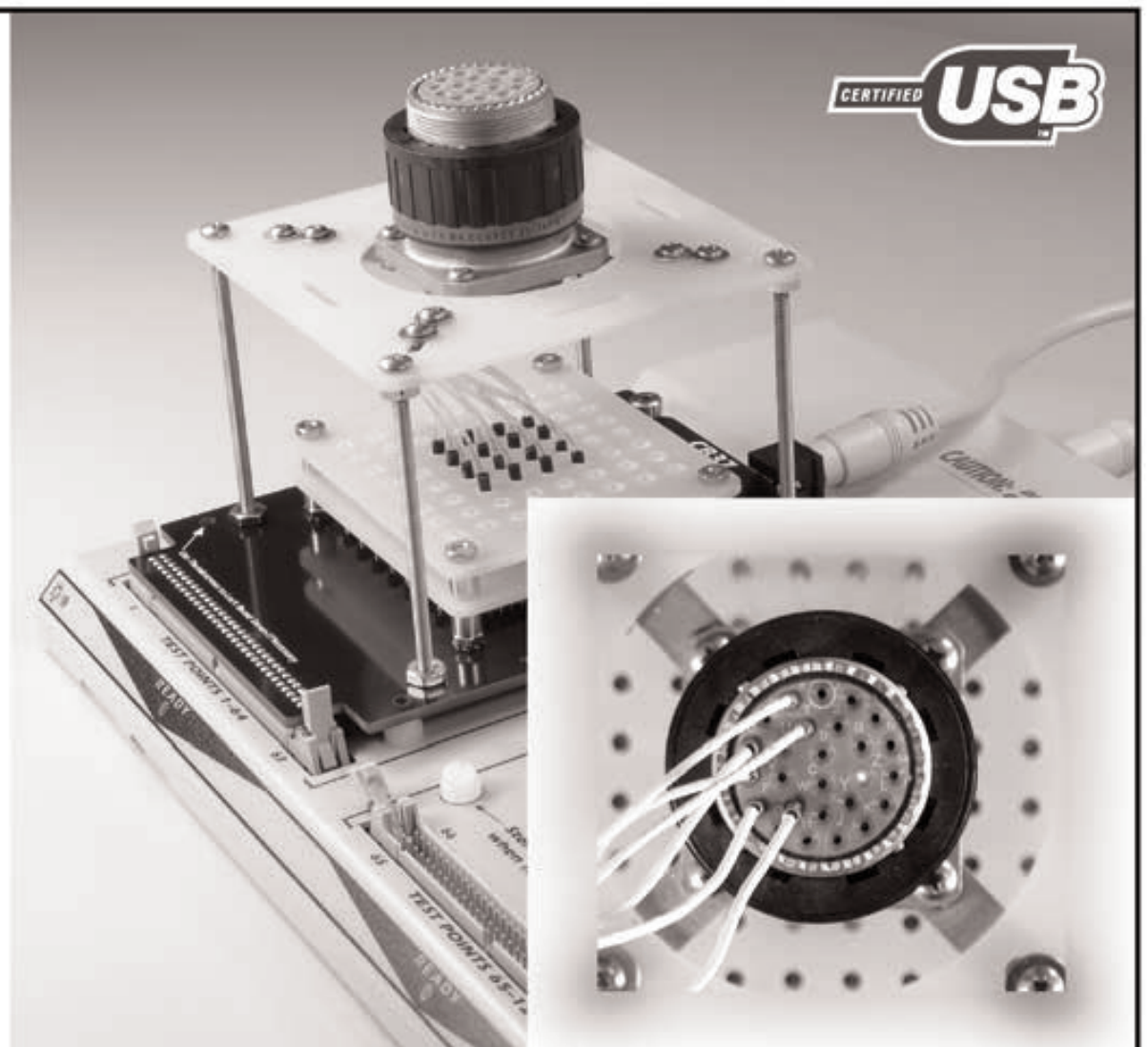
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protecting profitability (and even viability) in challenging times. It is a bottom line focus and considers the “realities” of the business – input costs, labour costs, competitive situations, and customer expectations. Growing the business however is a top line focus and considers the possibilities of the business – and possibilities are the result of imagination and dreams.

Many dreams do become realities, more often than we often realize, and the proof of this is all around us. All com-

panies that were ever started, including the one you are working for, started simply as somebody’s dream. With imagination, dreams become possibilities. With determination, possibilities become probabilities. And with good planning, probabilities can become realities.

Paul Hogendoorn is president and cofounder of OES, Inc. of London, Ontario, and currently serves as chair of the London Region Manufacturing Council. He can be reached at phogendoorn@oes-inc.com

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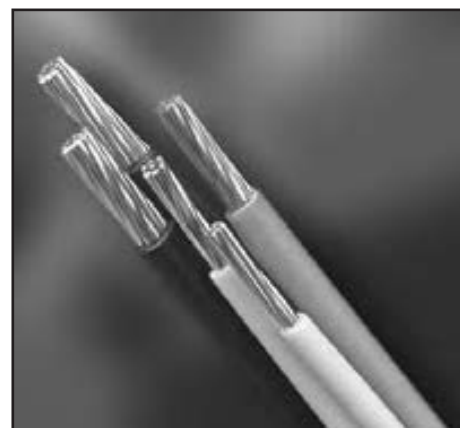
ment. Each strand was coated with copper so it "looked and acted like copper", and existing terminals could be used. The more Sumner and his team researched, however, the less attractive copper-clad aluminum became. "You still had the presence of copper", so the cost saving and weight benefits were minimal. They reasoned that "if you are going to do this, it's best to leap frog past copper-clad and go straight to aluminum or aluminum alloy." Thus is the path Delphi has chosen.

Randy Sumner hearkened back to his early days at Delphi (then Packard Electric), during the 1980's, when they produced some aluminum wire assemblies for GM. These were solid core as opposed to stranded. They were relegated to long, straight runs where flexibili-

ty was not an issue, such as harness assemblies for taillights. Copper became more attractive, and after about a decade, these products went away. Since then, applications for aluminum have typically been large gauge stranded wire and limited to power applications.

The first hurdles Delphi had to overcome with the use aluminum in wiring systems were flexibility and conductivity. Due to the softness of the material, solid core aluminum was excluded. Even with stranded aluminum, the soft individual strands need special processing. Aluminum has about 60% the conductivity of copper so Sumner indicates the need to upsize the wire "one to two, but typically one" wire gauge size from copper. The larger size means the size of the packaging is now critical, he adds.

So what are the specific applications for aluminum wire at Delphi? Sumner says that as long as you can account for the difference in conductivity, and where physical space allows, "just about anywhere copper is used." With that general criterion, Sumner did inform that Delphi has limited the size to .75 mm sq., "so anything from about 18AWG up to battery cables is a good fit." Due to the physical strength of the material, Delphi has determined anything smaller than that to be too fragile. A rough rule of thumb, Sumner indicated, is that using aluminum wire eliminates about 50% of the mass compared to copper, so "the



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Processing

Because of its physical properties, there are some differences in processing aluminum. Since Delphi is a manufacturer of the raw cable they use, Sumner was able to provide detail from that point. As previously stated, the individual strands are smaller and softer and require special handling during production. The raw stranded aluminum must undergo a special annealing process to harden the material. Whether cutting the final product at the manufacturer or at the wire harness facility, the operator must be aware of the tendency of aluminum to gall, or smear on the blades, due to the relative softness of the material. This can require more frequent maintenance to clean cutting blades, or, as in the case at Delphi, can mean developing materials to resist the galling effect.

When stripping aluminum wire, extra care must be taken to avoid individual strand cutting or nicking. This is due in large part to the lower conductivity of the material. Randy Sumner indicated at Delphi, an allotment of up to 10% for damaged strands is typical for copper. This would need to be more strictly controlled when stripping aluminum so there is no greater signal loss than that inherent to the material itself.

Another consideration is wire “stripability”, or the ease of which a slug of insulation can be removed from a length of wire. Rob Boyd, Crimping Product Manager for Schleuniger USA, sites that



Delphi Battery Cable

because of the softness of aluminum, the jacketing material pulls off with greater friction during stripping, and allowances must be made for this.

Dave Kelly, Chairman of SAE AE-8C2 Standards Committee on Terminating Devices and Tooling, and Standards and Industry Liaison for Daniels Manufacturing Corporation (DMC); added much to the more complicated discussion of crimping aluminum wire. He indicates that proper crimping is more difficult with aluminum because of such factors as aluminum creep (relaxation through thermal cycling) and softness. Although Dave’s expertise lies mostly with aerospace applications, the dynamics are essentially the same. “When crimping copper” Dave says, “on average, you reduce the cross sectional area of the total metal content by 20%.” Compressing copper beyond this level, he indicates, will make the material work hard-

Continued on page 10

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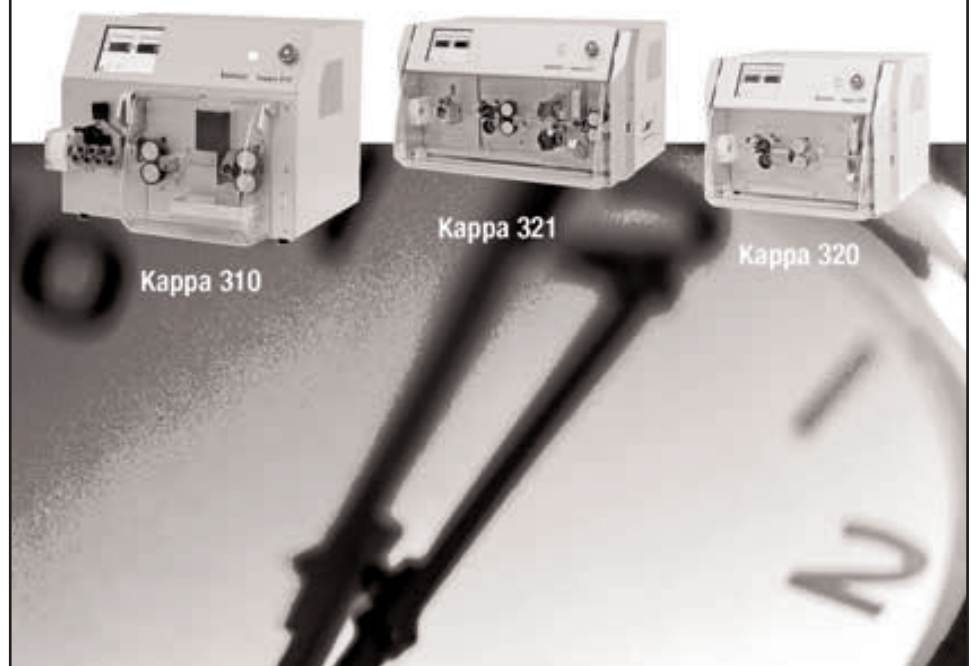
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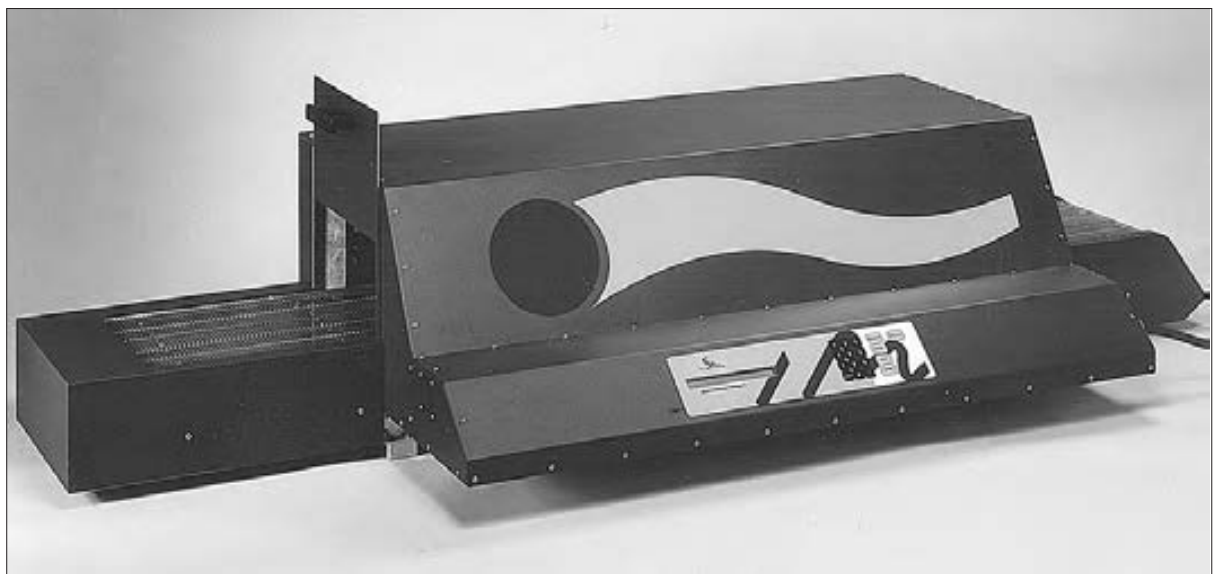
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Aluminum Wire

Continued from page 9

en and crack. Aluminum has a higher coefficient of thermal expansion (CTE) than copper. Because of the higher CTE, the aluminum contracts faster than the dissimilar terminal material when the temperature drops. The resulting creep or relaxation of the material through thermal cycling “requires a greater reduction of the cross sectional area when crimping – typically by 40% or more”, Dave says. The result is a much higher crimp force to compact the core and make a connection that will perform well and have sufficient duty life. “Fortunately the material is soft and cold flows better than copper” Dave concludes.

According to both Dave Kelly and Randy Sumner, some of relaxation through thermal cycling is unavoidable and leaves the door open for galvanic corrosion. For this reason, Sumner explains, the terminal and wire junction must be sealed. There are a couple of ways of achieving this, he notes. One of them is some type of conformal coating or molding covering the wire/terminal junction. There could also be some material inside the connector that would seal the junction, he adds. “Whoever comes up with the most innovative solution for sealing these junctions” will have the competitive advantage, Sumner says. The goal, he continues, is to do this at

high speed without a secondary operation.

It might seem logical to develop a new aluminum or alloy terminal to address the problem with crimping dissimilar metals. “Great complexity and cost is added when designing a new terminal” replies Sumner “and this would defeat any of the cost savings.” Delphi has made some alterations to the inside of existing terminals “to dig into the aluminum” in attempts to address the problems with softness and relaxation. Sumner reiterates, though, that sealing the terminals is the key challenge in the successful use of aluminum wiring.

The bottom line is that Delphi views aluminum wire as a cost effective lightweight alternative to traditional copper core cable with a possible weight reduction between 4 to 10 pounds per vehicle. According to a 2009 Delphi press release, Delphi Aluminum Cable will meet regulatory requirements including ISO-6722 (primary cable focus), LV112-2 (battery cable focus), and USCAR-23 (for cable). There is a great upside benefit in transitioning to aluminum wire, Sumner sums. “That is why effort is being made and investment is being put forth by Delphi and our competitors” to make sure this is successful.

Photos used in the above article are courtesy of Delphi Corp.

~WHN July/August 2010~

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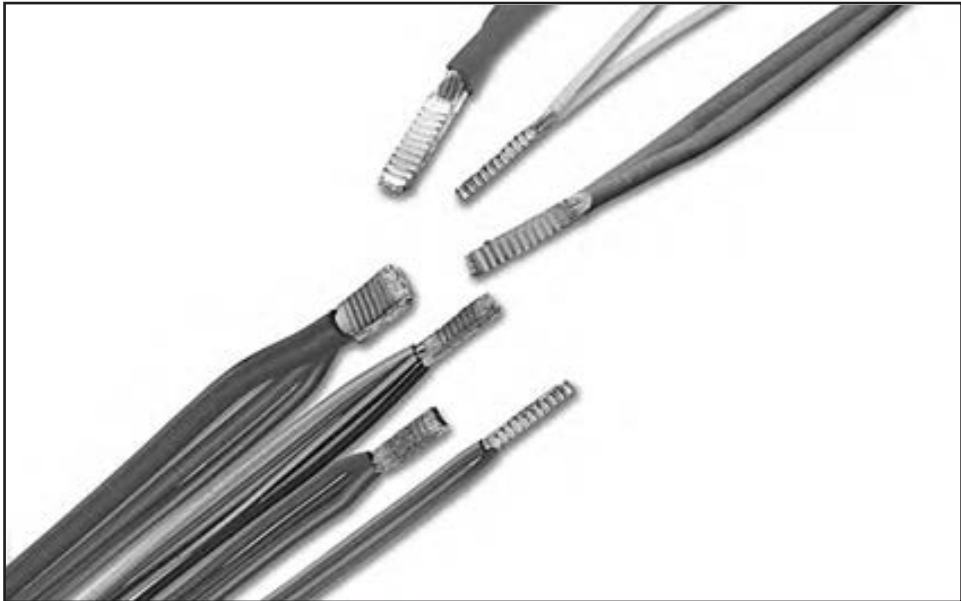
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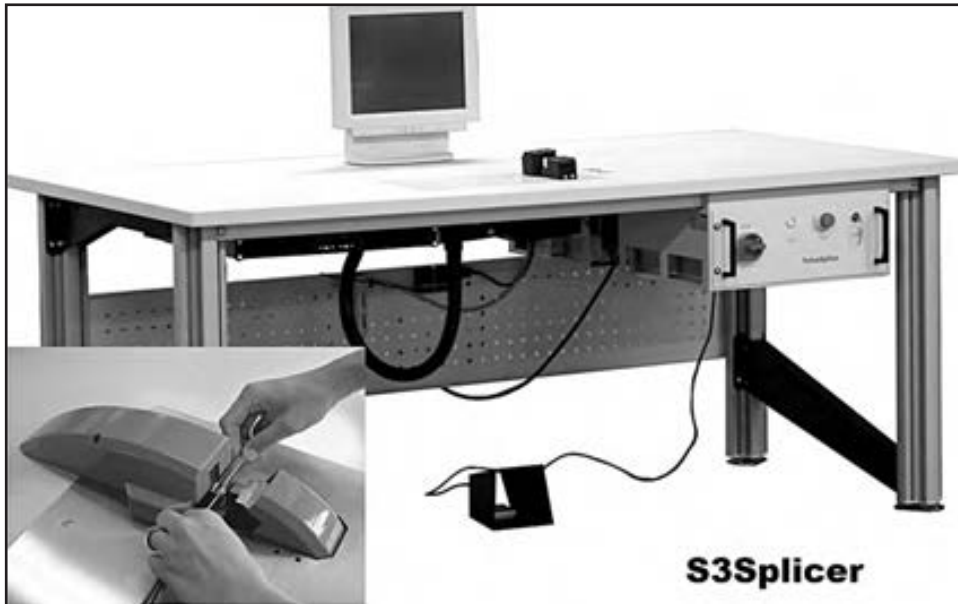
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NEWS PLUGS continued

FORTIS ZD Next-Gen Backplane Connector Revolutionizes Military and Commercial Aerospace Systems

Tyco Electronics, a leading global provider of electrical components, connectors, network solutions and specialty products, unleashed the future of backplane connectors with the advanced FORTIS ZD high-speed backplane connector, designed for military and commercial aerospace applications.

As demands on systems for real-time intelligence intensifies, the importance of high performance

interconnection becomes critical. Tyco Electronics set out to design a new connector system that supports increasing bandwidth requirements in a ruggedized format to withstand the increased shock and vibration requirements of emerging military applications.

“The goal was to achieve a system that combined the seemingly contradictory features of multi-gigabit speeds and extreme ruggedness,” said Kevin Rock, president, Aerospace, Defense & Marine, Tyco Electronics. “Our development engineering team has produced an outstanding product that more than met the challenges set to them – providing a strong path for the next generation of electronic systems in harsh environments.”

Tyco Electronics engineers provided ruggedization improvements in the high-speed backplane connector designs by marrying an electrically sophisticated, high-speed contact leadframe with a robust, industry-proven separable contact interface. A metal shell offers an even higher degree of robustness, both in the mating interface and the outer shell of the connector.

By combining the best features of commercial high-speed backplane connectors with proven MIL-SPEC contacts, the new high performance FORTIS ZD connector allows data rates of 10 Gbs+ and is designed to enable improved communications, unmatched situational awareness, and technologically superior command/ control and training.

For more information and to follow all the latest news on the FORTIS ZD, visit www.TheFutureUnleashed.com and follow us on Twitter @TycoElectronics.

Robert Henderson Joins Gem Gravure Technical Sales and Service Team

Gem Gravure Co, Inc. is pleased to announce the most recent addition to their staff of technical sales and service personnel

Robert Henderson brings 15 years of technical background to the GEM team. His experience with alpha-JET ink jet printers began with their introduction into the United States.

His expertise has grown to cover all aspects of this exceptional ink jet printing system. Robert's addition to the organization is particularly welcome with the launch of the latest alpha-JET, the evo.

“Robert brings a depth of knowledge that is appreciated by his customers and his colleagues. His ‘can do’ attitude and customer focus fit in well with the rest of the GEM organization” states Mark Kristoff, GEM National Sales Manager.

Robert will be working with the current Southeastern team: Cliff Schult, Rich Weis, Phil Collymore and Johnny Frederick.

Please contact Gem Gravure Co, Inc., 112 School Street, W Hanover, MA 02339.

Phone (781) 878-0456 or on the web at www.gem-gravure.com. for Robert Henderson's contact information or information on product identification solutions for your business.



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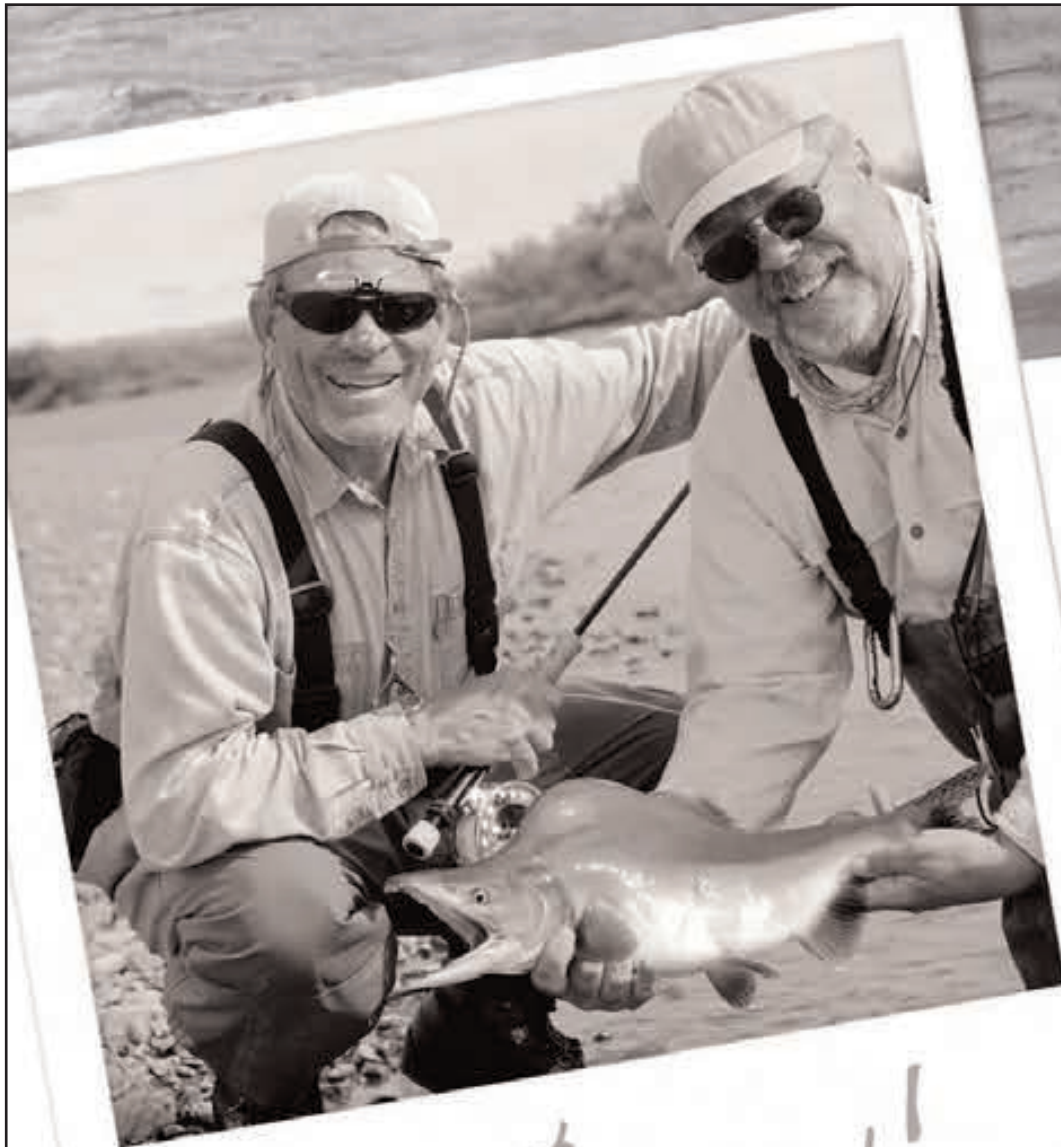
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In every issue of Wiring Harness News Anixter will bring you informative articles about wire and cable technology.

Thermoplastic vs. Thermoset Wire and Cable Materials

One of the most beneficial ways of distinguishing the characteristics of a wire or cable is to determine if the insulation or jacket material used is a thermoset or a thermoplastic.

The two materials have significantly different properties that influence their performance in a variety of applications. Understanding the properties of these two materials can be invaluable when selecting an economic product or trying to help prevent a possible meltdown.

What is a thermoplastic material?

A simple analogy to a thermoplastic is a chocolate bar.

When a chocolate bar is melted, it has

the ability to take on a new shape as it cools.

This ability to be molded again and again is characteristic of thermoplastics.

Thermoplastics are composed of chains of molecules such as polyethylene. Each thermoplastic molecule is composed of many smaller individual molecules, as seen here in Figure 1. When heat is applied to the material, the added energy will allow the bonds between the molecules to be separated, causing them to move around like a liquid.

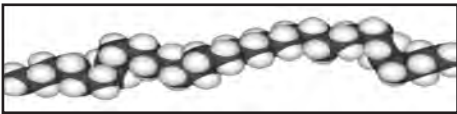
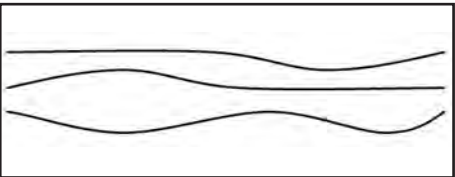


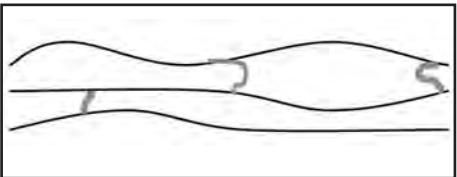
Figure 1: Structure of polyethylene

What is a thermoset material?

If a chocolate bar is analogous to a thermoplastic, thermoset materials can



Thermoplastic Molecular Chains



Thermoset Cross-linked Molecule

Figure 2: Thermoplastics vs. Thermoset



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be described as being similar to a birthday cake. Once a cake is baked, it takes its final shape.

Baking it longer does not increase or decrease the size of the cake. Ultimately if enough heat is applied, it will burn, but not melt like a chocolate bar. This particular characteristic is why thermosets are useful as durable materials that do not soften under high heat, such as car tires or flat roofing membranes.

Technically speaking, thermoset materials are those that are formed of basic polymer structures, such as polyethylene, and then cured or vulcanized. The curing process is what turns the plastic polymers into thermoset materials, which are also known as natural or synthetic rubber materials. The curing process can be done many ways, but the results are virtually the same. The long, individual polymer chains of the plastic become cross-linked by smaller molecules (shown as smaller red lines in Figure 2). The figure shows the different molecular structures of a thermoplastic and a thermoset.

Note: Because of the cross-linking required to make a thermoset, they are often referred to as cross-linked materials. In fact, when you see an “XL” in front of the abbreviation for a plastic such as polyethylene (PE), it means that it has been cross-linked, not that it is “extra large.” Such thermoset materials are called cross-linked polyethylene or XLPE.

How do I choose a material for my application?

Knowing that the key difference between a thermoplastic and thermoset is in the way they respond to elevated temperatures can be an important aspect of which material to choose. For example, thermoset materials are often chosen for circuits that may experience an overload. This is because thermoset materials have a reduced likelihood of failure if momentarily operated at the higher temperatures that often accompany an overloaded conductor. Comparatively, thermoplastics are often easier to strip, which makes them easier to process on automated equipment for large volume applications.

There are other considerations when choosing between thermoplastic and thermoset materials. Even though it is not true in every case.

Table 1 lists some general characteristics of the two material types and their implications to users.

The variety of materials available to modern wire and cable manufacturers is immense. This results in a wide range of properties within each material type. The table is a generalized summary that does not apply to every material. It is important to understand how the properties impact the performance of the product in the intended application. Generally speaking, within a given material type, the old adage, “You get what you pay for,” still applies.

For further information visit Anixter website at www.anixter.com.

Table 1 Material Characteristics			
Characteristic	Thermoplastic	Thermoset	How it affects the product
High temperature mechanical performance	Poor to good	Excellent	Increases survivability during emergencies or normal usage at high temperature
Coefficient of friction	Very low to moderate	Moderate to very high	Affects pulling tension, wire processing and tactile feel
Elongation	Poor to good	Good to excellent	Measure of stretch before breaking, encountered during installation, processing, and flexing
Tensile strength	Poor to excellent	Poor to excellent	Wide range in both material types, impacts durability and stripability
Colorability	Good to excellent	Poor to excellent	Affects identification, especially in low-light conditions
Heat deformation	Poor to good	Good to excellent	Impacts material durability when operating at elevated temperatures
Cold temperature compatibility	Poor to excellent	Good to excellent	Affects storage, handling, installation and usage in cold environments, including air shipment

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Alpha Wire is proud to announce the unveiling of its pharmaceutical equipment wire and cable product offering. With pharmaceutical processing equipment becoming more automated and precise, multi-functional cable components are essential.

Alpha Wire's pharmaceutical processing wire and cable increases your equipment's capability and reliability in conditions ranging from cleanrooms to the factory floor. With a full solution set, Alpha Wire solves the problems of signal interference, continuous flexing applications, and complex drive systems.

ability in conditions ranging from cleanrooms to the factory floor. With a full solution set, Alpha Wire solves the problems of signal interference, continuous flexing applications, and complex drive systems.

"As the pharmaceutical industry grows, the manufacturing demands have kept pace," states Mike Dugar, Director of Marketing at Alpha Wire. "Component failure can halt an entire production process, causing backorders and possibly the scrapping of an entire production run. Not only are our products designed for maximum reliability, our short lead times ensure that you won't have to wait for your order."

In addition to custom cable for unique designs, Alpha Wire is proud



Alpha Wire's Pharmaceutical Wire and Cable

to offer the following established products for pharmaceutical equipment:

Industrial Series V VFD Cable for variable-frequency drives particularly designed for extended duty cycles typical in mixing and conveying.

Industrial Series SF Flexible Servo Cable designed specifically for multi-axis mixing systems, resolver and encoder feedback, dynamic braking systems on conveyors, and other servo motor-driven applications.

Flexible Motor Supply Cable features a premium PVC jacket for oil resistance in an MTW-rated cable for any motor-driven component system requiring flexibility and tight clearances.

Xtra-Guard® 1 Performance Cable has a specially formulated PVC jacket that prevents heat build-up for unstoppable reliability in a communication and control cable.

Industrial Series XM Flexible Control Cable for continuous flexibility in processing equipment control systems and tray-rated applications.

For additional information, contact Alpha Wire at 800-52-ALPHA (522-5742) or visit www.alphawire.com.

Acquisition Expands ASG's Product Offering and Increases Workforce in Cleveland by 35%

ASG, a division of Jer gens, Inc., a leading manufacturer of standard tooling and specialty fastener products, announced they have acquired all of the assets of MicroTorq LLC of Traverse City, MI. MicroTorq, a manufacturer of precision electric fastener systems, including their industry standard transducerized screwdriver system. Terms of the acquisition were not disclosed.

Byron Shafer, General Manager for ASG said "This acquisition transforms our business in Cleveland, OH and makes us a comprehensive engineering, design, R&D and manufacturing facility, with a focus on DC

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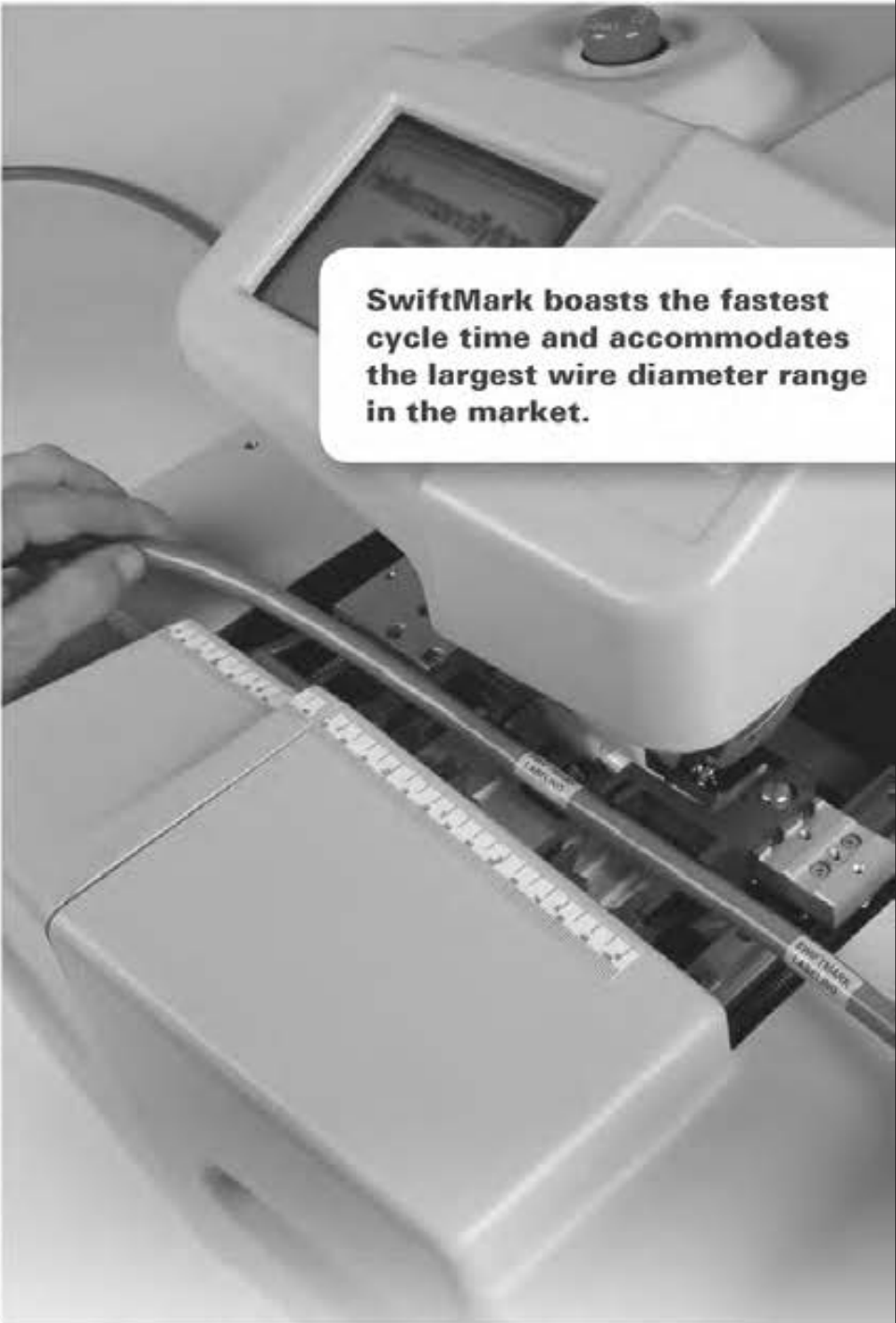
Continued on page 20

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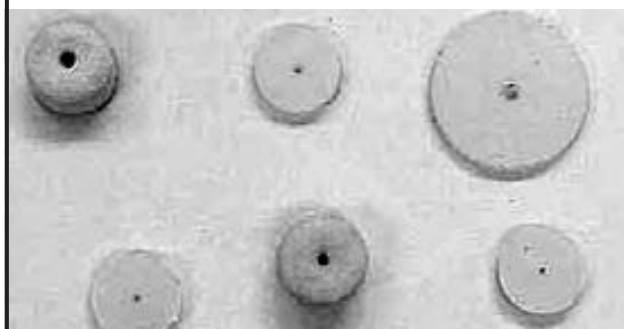
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NEWS PLUGS continued



Continued from page 18

electric transducerized precision fastening tools. In addition, the acquisition enhances our ability to provide complete fastening solutions to an increasingly quality conscious customer base in the critical / controlled fastening markets, such as automotive, aerospace and medical assembly industries."

The revolutionary control system will be branded as X-PAQ, for its extreme precision, accuracy and quality. This product line will be mar-

keted under the newly created ASG Precision Fastening Group. ASG will provide full service repair, maintenance and calibration services for all ASG branded screwdrivers, as well as all comparable electric transducerized screwdrivers currently in the field, regardless of where or when the tool was purchased.

ASG, a division of Jergens, Inc. specializes in precision assembly equipment for a wide range of industries, from light electronics to heavy industrial applications. To find out more about ASG comprehensive product offering, phone 216.486.6163, e-mail jaci.schill@jergensinc.com or visit us online at www.asg-jergens.com.

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New Amphenol NEPTUNE Connectors with RADSOK Technology Increase Power in Rugged Environments

Amphenol Industrial, a global leader in interconnect systems, recently enhanced its line of NEPTUNE connectors designed for the most demanding power generation and distribution environments. The rugged, high-performance connectors pair an aluminum housing with Amphenol's patented RADSOK contact technology to provide increased amperage and voltage in a compact, lightweight package.

At 50% smaller in size and weight than competitive models, the NEPTUNE series connectors are ideal for fast and easy interconnections to modular power equipment in virtually any modular power application. Users in both on and off-shore oil exploration, convention centers, manufacturing plants, production platforms and communication shelters as well as those using portable power equipment and geophysical trucks and skids can benefit from these safe, dependable power interconnects.

Amphenol's new IP68-rated connectors, which feature a dielectric strength of 1,800 volts, are available with plugs and receptacles from 30 amps through 400 amps at 600 volts. The interconnects incorporate Amphenol's patented RADSOK system, an electrical terminal based on a hyperbolic grid configuration that enables lower insertion forces than standard contacts, while increasing available amperage and voltage.

NEPTUNE's precision machined aluminum components are high-tensile-strength bar stock, finished with a hard coating to 40 points on the Rockwell C scale and are heat resistant to +750°F. Operating temperature for the connector is -67°F to +225°F.

Crimp Inspection System

PC based system with bar code scanner, micrometer, caliper, pull tester, microscope and USB camera



First the operator scans the circuit number, his worker number and the machine number. The target crimp specs and master image are recovered from the hard drive and displayed. Using current production samples the operator measures the conductor and insulation crimp heights and widths. The operator measures the pull force. The operator captures an image, either cross section or terminal image. When finished the data is stored in Excel.

Set Up Master ver 1.07

Circuit # WXYZ Hold Release Report Chart Report Data Master Maintenance Quit

Terminal #1 Terminal #2

Dimension	Target	Target +/-	Actual	
Cond. CH	0.033	0.002	0.034	Measure
Cond. CW	0.070	0.002	0.071	Measure
Ins. CH	0.080	0.005	0.080	Measure
Ins. CW	0.088	0.005	0.088	Measure
Pull	20.00	---	31.18	Measure

Master Image Sample Image Shutter

cross section images or terminal images can be captured

Save into Excel



Scan the circuit number, operator number and machine number



Measure conductor and insulation crimp heights



Measure conductor and insulation crimp widths



Measure pull force



Capture cross section image or terminal image

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Mini style applicators with mechanical feed mechanisms are supplied in a variety of feed configurations. Adaptable to most crimping presses.

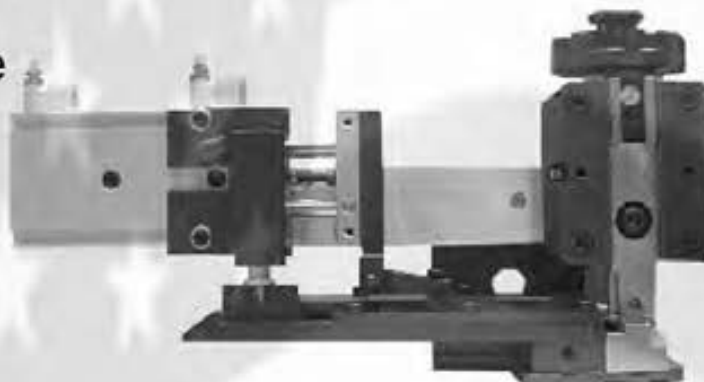


Model 1700



Model 2000

Pneumatic feed mini-style applicators can accommodate terminals with center to center distances up to 2 inches.

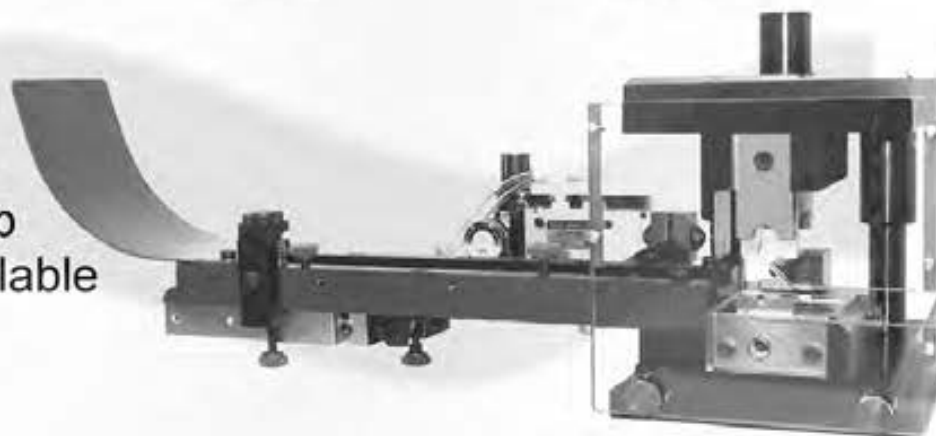


Model 1500



Model 2100

DSA applicators are designed for large terminals manufactured from heavy gage material with center to center distances up to 3 inches and widths to 3.5 inches. Available in left to right, right to left and rear feed configurations.



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Vehicle Harness Design Tools Model the Real World

John P. Wilson
Business Development Manager
Integrated Electrical Systems
Division, Mentor Graphics Corp

Vehicle manufacturers are faced with many of the same concerns that confront other industrial businesses: reducing design and manufacturing costs, reducing lead times, and improving product quality. Builders of automobiles, appliances, and even apartment buildings have turned to computerized design tools to get

these challenges under control. Auto makers have long relied on mechanical computer-aided design (MCAD) platforms for their drive train and body design projects. More recently, solutions for harness design have emerged to solve the burgeoning problem of electrical and wiring system complexity.

In the harness engineering department, general-purpose electronic drafting tools and spreadsheets are gradually giving way to dedicated harness design packages with capabilities no



John P. Wilson
Mentor Graphics Corp.

drawing tool can ever match. Engineers create designs using "intelligent" representations of electrical objects selected from an integral components library.

This offers multiple benefits. When the engineer moves a component its on-screen "wires" and associated data automatically move with it, remaining connected. A component symbol such as a diode can be inserted into an existing wire with a simple drag-and-drop operation. The software automatically opens the wire and connects the diode. Purpose-built electrical design software understands the intent behind the task and eliminates several tedious steps along with their opportunity for errors.

Working with Intelligent Objects

Because dedicated electrical design tools work with intelligent objects, electrical simulation and analysis capability is innate. This moves the whole electrical design process into the realm of *virtual prototyping* wherein an intelligent digital model of the circuit behaves almost exactly like its real-world hardware counterpart. The engineer can study electrical behavior simply by clicking on a switch symbol to observe the results of an embedded circuit analysis.

Active portions of the circuit can be highlighted on-screen and thereby help the engineer understand the design's behavior. When the "Dome Lamp" switch is thrown, does the light illuminate? The on-screen image displays the answer visually.



A little help here, please!

ETCO bails out a customer with a supplier problem.




A supplier of an electronic component for a major automobile manufacturer went out of business leaving the automaker with no ISO/TS 16949 supplier. While the automobile company was able to get the die for the part during the supplier's bankruptcy, the tool package & documentation was lost.

At the automakers request, ETCO took the die and reverse engineered the tool package & process. Once that was achieved, ETCO was able to start producing the part quickly and efficiently, helping the manufacturer out of a tight spot on very short timing.

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If you have a problem or a need for a custom product solution call Sean Dunn at 401.467.2400 X 103 or e-mail him at sdunn@etco.com. He'll assemble a team of ETCO engineers to address your problem.

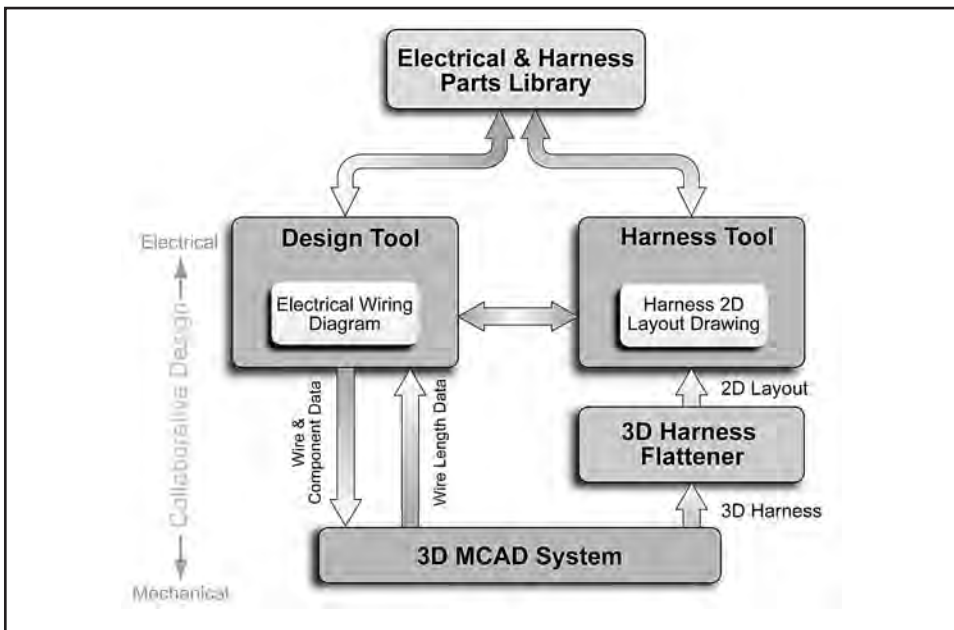


Figure 1: The interface with the 3D CAD system enables design data such as updated wire lengths to be fed back into the electrical virtual prototype to analyze the effect on electrical performance. In this Mentor Graphics VeSys 2.0 design flow, the MCAD the design systems exchange data interactively over many design iterations.

Alternatively, the circuit analysis tool can calculate currents and voltages at any or all points within the design.

Virtual system prototyping produces results far more quickly than working with a hardware prototype. That in itself is a great advantage when schedules are tight and equally important, the engineer can quickly modify the design to optimize it through a series of change-and-simulate iterations. Figure 1 illustrates a collaborative design environment that supports this process.

Optimization Reduces Manufacturing Costs

A schematic drawn with a general-purpose drafting tool is a static thing. In contrast, a design rendered with intelli-

gent objects and embedded behavioral knowledge lends itself to recursive testing. Because each individual test cycle is brief, it is possible to assess many scenarios in a short time. By simulating a number of design alternatives, the engineer can determine where less expensive parts might suffice, or where less redundancy is needed, or where a smaller gauge of wire will do the job. A report summarizes the results both schematically and with tabular details. Analyses at this level applied throughout the vehicle can provide valuable insight into variables that affect cost, weight, and more.

Continued on page 24



Waytek has Staying Power

40 Years of Change and Growth

The 70's was a time of disco dancing, the Watergate scandal, and 25 cents a gallon gas. Waytek, electrical distributor, joins Lego, Post It brand and Samsung Engineering in celebrating 40 years of business. Wayne Larson started Waytek in 1970. He initially worked as a manufacturer's rep in the industry and made wire harnesses. He hired Bob Lamoreaux, then his brother Norm to help with the growing company.

Waytek strives to provide exceptional customer service. Bob remembers one of his first orders. "It was for battery cables and we hand delivered it to them the next day, Christmas. Our first customer 40 years ago still does business with us today." In 1980, Waytek transitioned to become a stocking distributor. Although Waytek did not continue to produce wire harnesses, the owners utilized their vast experience to supply quality products to other manufacturers in the industry. Currently, Waytek distributes a wide range of electrical supplies including wire, circuit protection, connectors and custom services.

Over the years, Waytek has prided itself on keeping up with the ever-changing technologies of business. Bob was teased about the purchase of Waytek's first fax machine in 1980. "It sat there for a few months not doing anything," recalls Bob. One day, it started working and didn't stop; Sales couldn't keep up with processing the orders. The first website was created in 1996 with no ordering capabilities. Each year, Waytek progressed with the demands of its customers; now ordering online is standard. With continued growth, Waytek has moved into larger buildings to accommodate its increased inventory and for future expansion. In 2007, Waytek made further progress by automating the fulfillment system which increased order accuracy and speed. The second generation is now running the company; their vigor will continue to grow with the changing times.

One thing that won't change is the long-time foundation of valuing employees, which resonates down to the customer. Because employees feel valued, they enjoy what they do; in turn, they treat customers with the same respect they receive. This year, Waytek celebrates not only 40 years of being in business, but also the company celebrates 40 years of offering superior customer service. 40 years- and counting.



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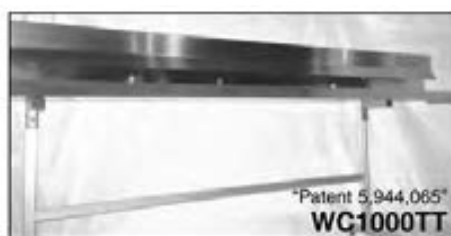
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Continued from page 23

To cite an example drawn from the author's experience, a round of electrical design changes in a new harness created excessive voltage at a particular component, drastically reducing that component's life expectancy. The relevant circuitry was spread across five different harnesses within the vehicle. Using a Mentor Graphics electrical design package, a series of alternative scenarios was simulated. As a result it was discovered that making minor changes within just two of the five harnesses yielded an 85% improvement in the component's life expectancy. All of the experimentation was carried out

within just a few hours, with no need for hardware trial-and-error.

From Specifications to BOM the Fast Way

Specifications delivered to harness suppliers may include documentation such as wiring diagrams and non-scaled 2D physical diagrams of the vehicle harnesses. Historically suppliers have manually extracted a bill of materials (BOM) and created manufacturing documentation, including wire cutting lists and tooling charts, from this information. Part number cross-referencing is accomplished by searching catalogs or referring to reference lists of approved components, after which the necessary

components can be ordered. At long last, comprehensive component price and availability details become visible and total costs and delivery dates can be projected.

This litany of steps amply demonstrates why automated harness design tools are supplanting older methods. Full-featured applications provide specialized functionality ranging from bundle layout to creation of wire tables. An integrated components library enables automated insertion of appropriate connectors, terminals, clips, grommets, and tubing into the evolving design. Figure 2 (page 32) depicts a harness drawing incorporating all these elements. Built-in text and part number search tools make it easy to cross-reference part numbers and pick approved components from the library.

The design tool's reporting features can quickly generate the BOM and even load the information automatically into an MRP system. These record-keeping and retrieval features can significantly reduce overall lead times, and allow costs and delivery dates to be accurately projected earlier in the development process.

Making the Leap from Design to Manufacturing

Next, the harness design must be readied for manufacturing. That means full-scale detailed drawings of the production form-boards upon which the harnesses will be assembled. Procedures and checklists must be generated for setting up assembly machines. Numerous annotations and assembly notes are also needed. Needless to say, clinging to traditional methods can add time, cost, and error to the process.

A capable design package can automate the creation of the full-sized form-board drawings directly from the harness design drawings, even as the engineer switches quickly between the two different diagrammatic representations when monitoring the conversion. Report generation greatly simplifies the creation of manufacturing documentation. Wire cutting lists, splice instructions and sub-assembly instructions spin out of



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Common Battery Terminal Alloys	Electrical Conductivity
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Continued on page 32



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Cablesan's Series 90 TestRite programs run under the most popular Windows operating systems, and can import wire lists, net lists, and CAD data. TestRite's browser window allows you to provide setup and work instructions using HTML, image, and audio files. With a simple click, everything is displayed, stored, and can be printed in seconds. High voltage and high current models are also available. Put simply, you reduce test and assembly cost dramatically. Visit our website or call us at (909) 483-2436 for more details. Cablesan, Inc., 3022 Inland Empire Blvd., Ontario, CA 91764



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YnZ's Yesterday's Parts

Continued from page 1

Interestingly, Zdunowski made his harness from wiring removed from old train locomotive harnesses. He used the same method during the restoration of his 1930 Chevrolet and, because of the judge's interest, decided to make 11 harnesses for '28 and '30 Chevrolets to try to sell at the Vintage Chevrolet Club of America national meet at Buena Park, Calif., in November 1969.

"In one hour I sold them all," Zdunowski said. "Those two different harnesses have led to us having available over 6,000 harnesses for different makes and models now."

The vehicles range from Aston Martins to Cords to Hudson-Terraplanes to Oaklands to Porsches to Whippets and practically everything in between. Custom harnesses are produced, too. Among the harness offerings are main, taillight, turn signal, overdrive, power window, power top, dash, engine and door panel.

To further serve customers' needs, YnZ's distributes harnesses made by Bauer Electronics in Bend, Ore.; M&H Electric Co. in Santa Fe Springs, Calif.; and American Autowire in Bellmawr, N.J. Factoring in the firms' products, YnZ's makes more than 40,000 different harnesses available.

YnZ's began in January 1970 when a partnership was formed between Gene and Donna Zdunowski and her parents, Sid and Vi Young. The company name

was formed by the first letters of each couple's last name.

At first, each partner worked in the business part time but eventually went full time. Donna Zdunowski was a homemaker and mother to her and Gene's two daughters. Vi Young was the office manager for a furniture chain, and Sid Young was a journeyman steamfitter and sheet metal worker for the Santa Fe Railroad.

Gene Zdunowski began in 1969 as a vector biologist for the San Bernardino County (Calif.) Health Department. He studied the origin and prevention of diseases spread to people and animals by such critters as rats, mosquitoes, flies, lice, fleas, ticks and mites. The diseases included West Nile virus, Rocky Mountain spotted fever, bubonic plague, encephalitis and Lyme disease.

Although Zdunowski was named assistant department director in 1979, he left the security and guaranteed income of a regular job. His first day full time at YnZ's was July 7, 1981.

"I knew I could make it work because I was holding back on advertising and putting in extra phone lines. It was time to let my foot off the brake," said Zdunowski, who noted he took a 66-percent pay cut from his health department job. "I had to do whatever it takes."

Such commitment has meant YnZ's has experienced growth every year. Even when the general economy took its most recent dive, the company grew

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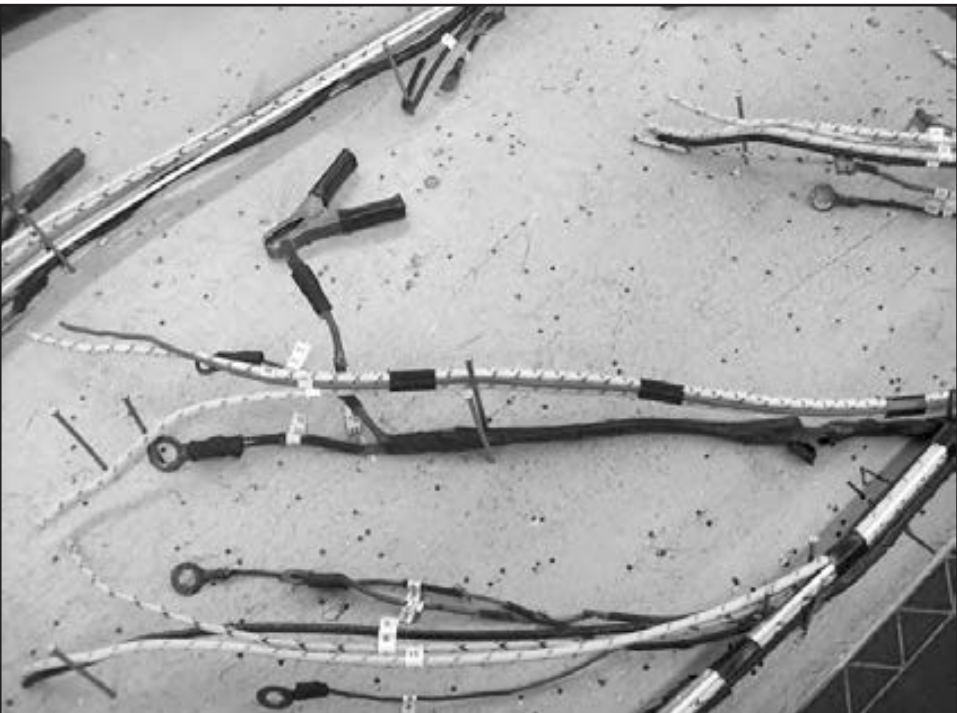


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Using the old harness as a template, YnZ’s constructs the new harness on top.

10 percent in 2008 and eight percent in 2009.

“My wife has great common sense for business and is a natural at watching cash flow,” Zdunowski said. “We’ve taken out only one business loan and self-financed everything all these years. We use a simplistic target of last year’s gross and look at the financials every month. If we’re falling behind, we find out why and make adjustments.”

The best years were 1997 and ’98 when annual growth was 15 percent. Profit has increased as well, primarily due, Zdunowski said, to the efficiency of the employees “who have concentrated on working smarter, not harder.”

Such growth has occurred because of

excellent products and service. “I am proud of the quality product we have to offer to the hobby,” Zdunowski said. “It stands head and shoulders above what else is out there. We go to the extreme in our detail to make the product the way it originally was. People want a duplicate of what was in there when the car was new.”

Perhaps the ultimate test for quality is the annual Concours d’Elegance vehicle show in Pebble Beach, Calif. The invitation-only event is the one of the most prestigious competitions for antique and classic cars and motorcycles in the world.

Continued on page 28

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YnZ's Yesterday's Parts

Continued from page 27

The 175 vehicles are judged on originality, authenticity, design, styling and elegance. Fourteen of the class and award winners in the 2009 show had YnZ's harnesses.

Each harness replicates the original with the correct colors, coverings and terminations on the wires. First-run har-

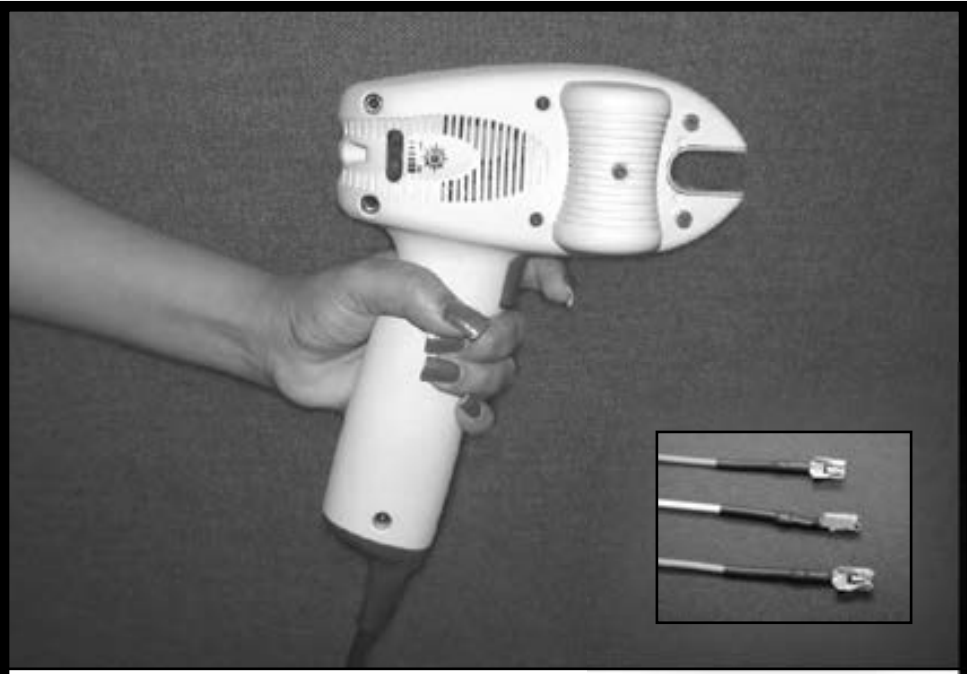
nesses often are copied from original harnesses. Then templates are made for successive copies of the harnesses.

Wiring diagrams provide additional information for harness accuracy and production. Also invaluable are electrical engineering drawings produced at the factories that made the vehicles.

New processes have made copies better than the originals while still retaining the same appearances and



Some harnesses require the application of “old fashioned” rubber tape wrap as in the above harness.



Our Gun out-shrinks the competition 5 seconds vs. 12 seconds*

*polyolefin, 5" length

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functions. For instance, Zdunowski pointed out that in 1939 Studebaker wrapped its truck harnesses with non-adhesive rubber instead of cloth. That wrap has been copied for use in other vehicles, but silicone was added so the wrap is more resistant to ozone, oil and gasoline. The same protective technique was used on rubber terminal shanks.

Initially, YnZ's made its own wire and braided and lacquered it, but production was phased out by 1976 when a supplier was found. It served YnZ's for 30 years until an air pollution management agency objected to the wire lacquering. Since YnZ's orders were a small percentage of the firm's business, the special wire was discontinued, forcing YnZ's to find another manufacturer.

Wire orders are placed four times a year. Between customer purchases of harnesses and wire only, YnZ's buys between 750,000 and one million feet of wire. Zdunowski estimated the price of copper increased 400 percent in the last 15-20 years. He knows wire pricing will fluctuate according to the commodities markets because of the copper and the cotton and vinyl coverings.

Braiding is a common operation at the company. It has five New England Butt braiders with 16, 24 and 32-carrier capacities that can braid thread, jute and

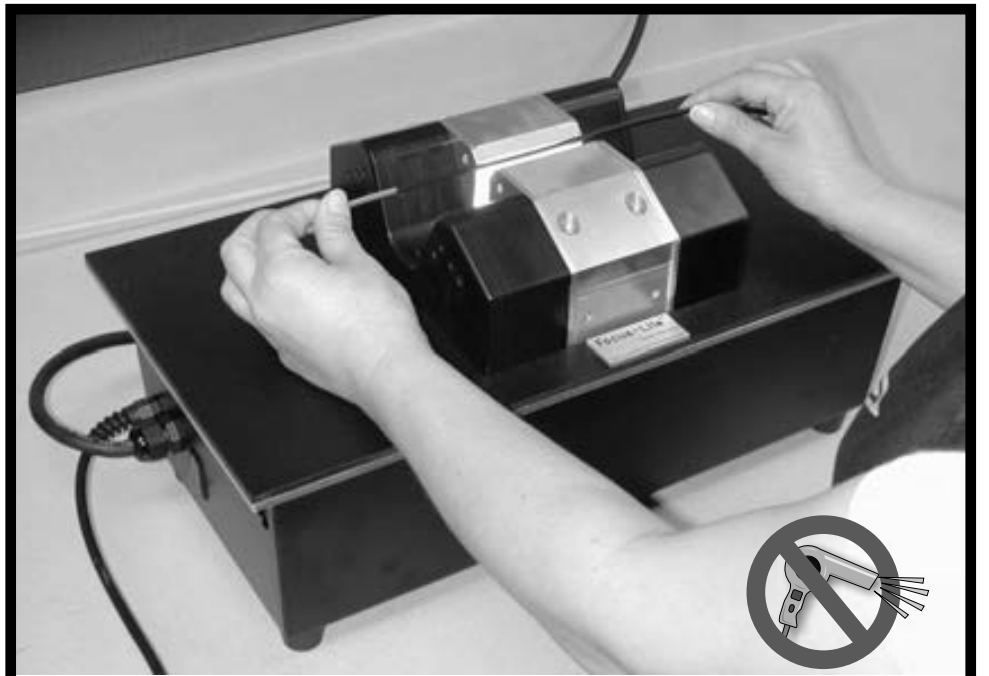


YnZ's uses a New England Butt 16-Carrier Braider for small diameter braiding jobs.

other materials. Combined with vinyl and other coatings, YnZ's has more than 210 colors of wire.

More than 70 unique terminations and connectors developed by YnZ's are in stock in addition to more common terminations and connectors. Also available are shrink tubing, tape, ignition and sparkplug terminals and boots, rubber sleeving, sockets, switches and battery cables.

Continued on page 30



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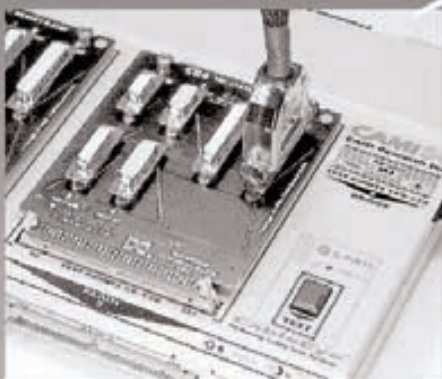


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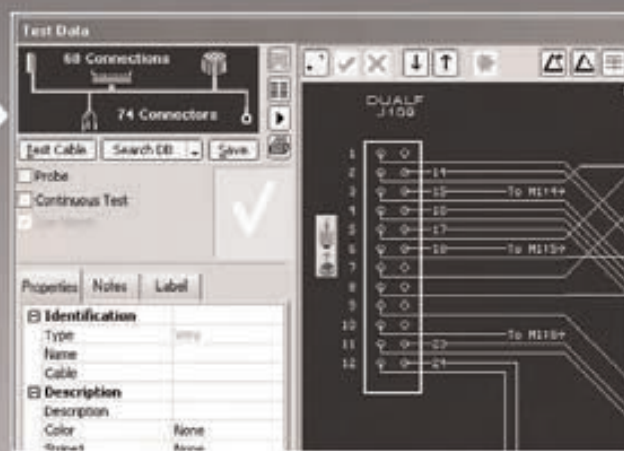
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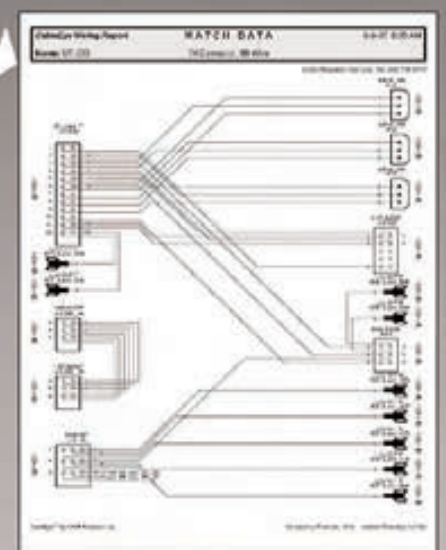
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YnZ's Yesterday's Parts

Continued from page 29

All the items used in harness production may be purchased separately. They often are bought by other harness makers and professional shops doing 6-10 restorations a year.

Total number of customers annually averages 1,500. They are located all over the world - North America, South America, South Africa, Australia, England, Germany and Italy among them. Why, earlier this year a person in Russia ordered a harness for a 1941 Plymouth.

Zdunowski stated repeat customers are 40 percent of the total. The Internet produces more than 40 percent of the

customers. The company has had a Web presence since the mid-1990s, and sometime this year visitors will be able to order through the site. E-mail marketing is employed by using addresses of people who contact YnZ's on the Web.

Customers also learn about YnZ's through its ads in print publications such as Hemmings Motor News, Cars and Parts, Old Cars Weekly, Collector Car and numerous club magazines, and through Google AdWords and search engine optimization. All such media cost the company up to \$20,000 yearly.

Further exposure is gained through membership in several car clubs, Specialty Equipment Market Association and

the Antique Automobile Club of America. YnZ's had booths at three car shows and swap meets in 2009, down dramatically from the 23-29 attended annually in the initial years of the company.

Brian Tarbet manages the company. He also answers technical questions and handles the information technology, which includes tracking production stages by computer. The other key employee is production lead Bonnie Ruotsi, who started at the company 30 years ago.

Harnesses are made by five other persons, and they specialize in certain makes and models of vehicles. Some builders are cross-trained on different

vehicle harnesses. One person does braiding, pulling orders and shipping, and another person, who is part time, produces battery cables.

The employees have longevity with the company, partly due to the benefits. They include two weeks of vacation, 401(k), health insurance, paid holidays and quarterly profit-sharing. From the latter, one employee earned a bonus amounting to \$2.60 per hour.

Production is accomplished with such equipment as hydraulic and electric crimpers, thermal-tipped solderers, charcoal filters for solder fumes and testing devices. Equipment on each of the six production tables costs \$4,000.

The work is done in a 4,500-square-foot unit of an 11,000-square-foot two-story building owned by the Zdunowskis. They had it built in 1987 to consolidate operations that were in the couple's home and a barn near Fontana, Calif. That same year the Youngs officially retired, although Vi Young continued to work till she was 83 five years ago.

For more information, call 909-798-1498, fax 909-335-6237, e-mail gene@ynzyesterdayparts.com. Visit www.ynzyesterdayparts.com or write to YnZ's Yesterday's Parts, 333 E. Stuart Ave., Unit A, Redlands, CA 92374.

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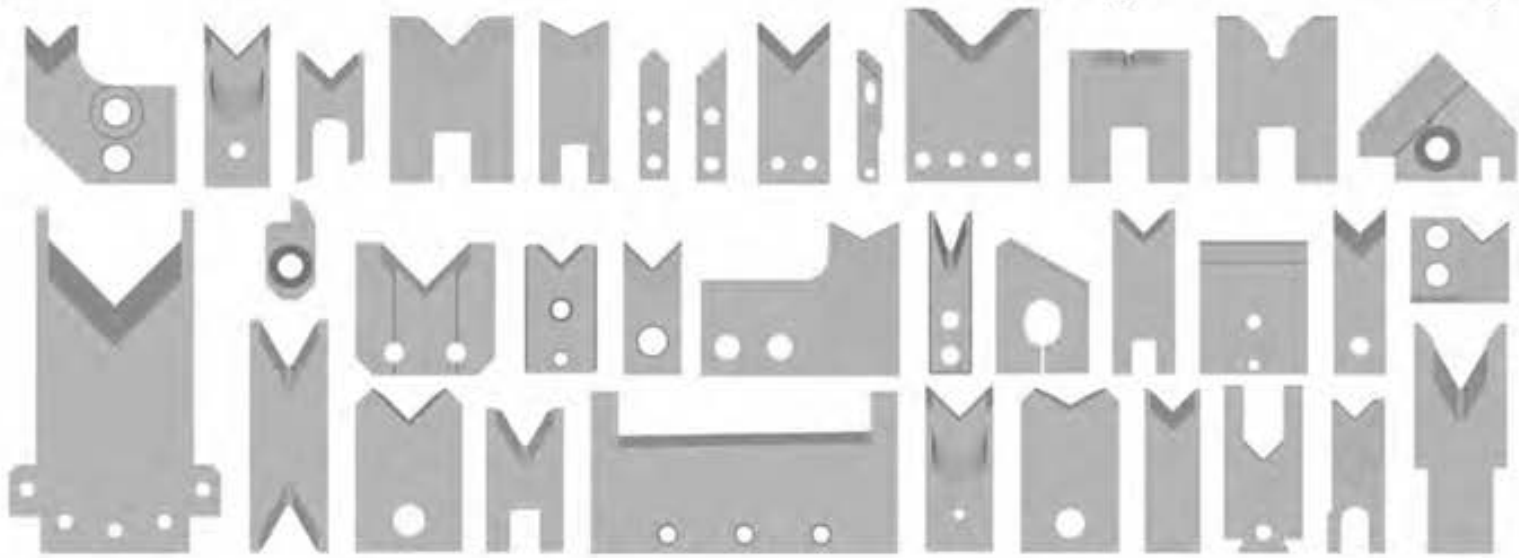
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Vehicle Harness Design Tools

Continued from page 24

design data captured earlier in the process, reducing setup times and manufacturing errors. Figure 3 depicts the data hierarchy in this process.

“Your Design Looks Great... Let’s Change It!”

Sooner or later almost every harness design will undergo modifications to add features, correct problems, or reduce costs. Updating electrical and harness designs is typically a carefully controlled formal process. Any changes that affect electrical characteristics must

be incorporated into the wiring design and analyzed for their effect on electrical performance. Similarly if physical changes are made to harnesses these must be assessed against mechanical constraints.

Typically these updates are made via change control documents sent between the vehicle manufacturer and the harness supplier. These documents have always been necessary to ensure that both parties, OEM and supplier, understand all the details of all the changes. They embody the old admonition, “Put everything in writing,” with all the effort that implies.

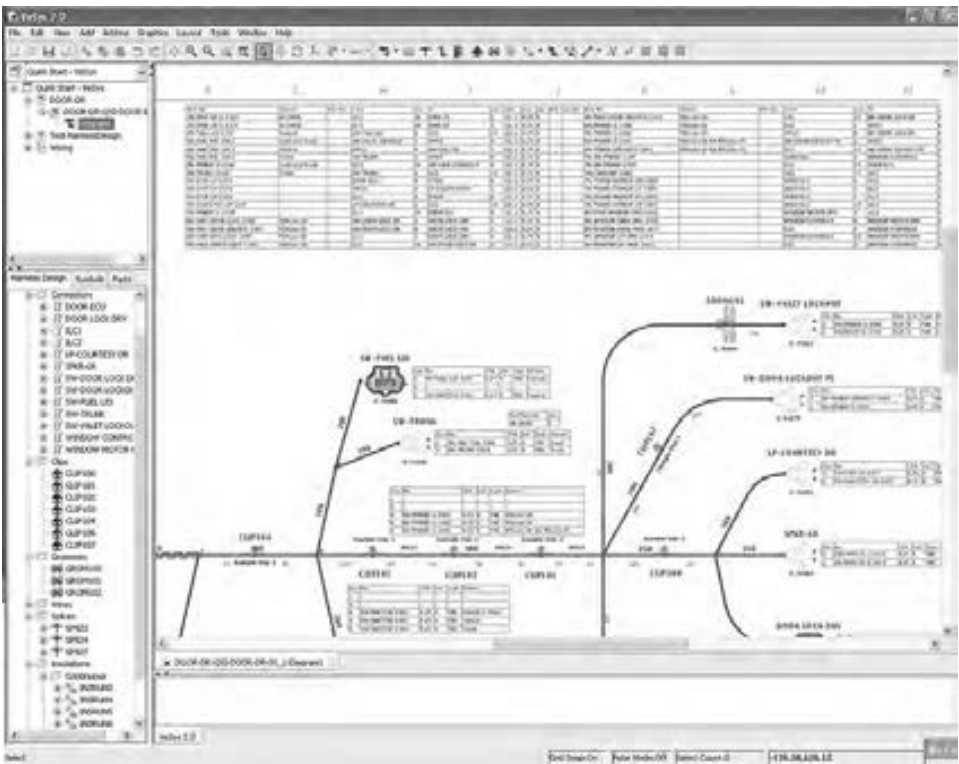


Figure 2: This detailed harness drawing from Mentor Graphics VeSys 2.0 delivers automatically-generated wire lengths and terminal and seals selections as well as a full Bill of Materials.

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If the design derives from an automated harness design solution, the relevant data is innately stored as part of the design process. The vehicle manufacturer and the harness supplier can easily pass design data files back and forth, and by definition these files contain the current data supporting the manufacturing formboards and assembly instructions. Information exchange and collaboration across disciplines, organizations and locations becomes more robust.

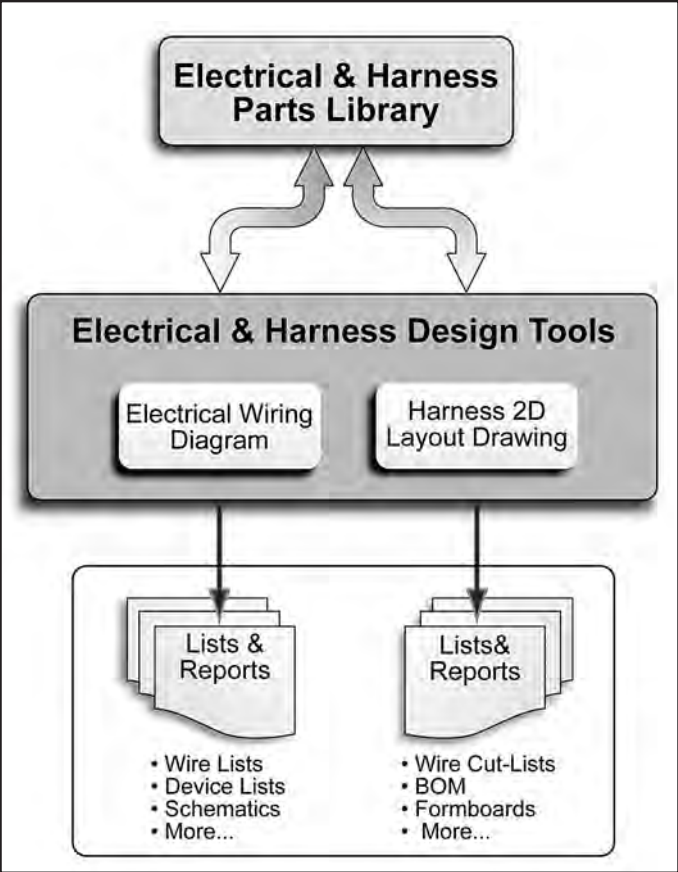


Figure 3

Looking Toward Tomorrow

Commercially-available harness design software provides vehicle designers and their suppliers with a way to make the electrical design process more efficient. Common tasks such as circuit design, harness layout and manufacturing data generation can all be improved. Embedded simulation and validation can help engineers optimize their designs

and detect errors early in order to improve product quality and reduce production costs. These powerful tools will make it possible to keep pace with tomorrow’s more complex, more diverse harness configurations. For more information please contact James Price on +1 503 685 1778, at james_price@mentor.com or visit www.mentor.com/electrical.

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NEWS PLUGS continued



Continued from page 20



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The nickel silver alloy plated contacts are interchangeable and reversible to suit specific needs. Optional gold plating is available. Conductors are readily terminated to easily accessible pressure wire terminals. NEPTUNE connectors are resistant to 60 Gs, exceeding Mil-STD-167-1 vibration standards.

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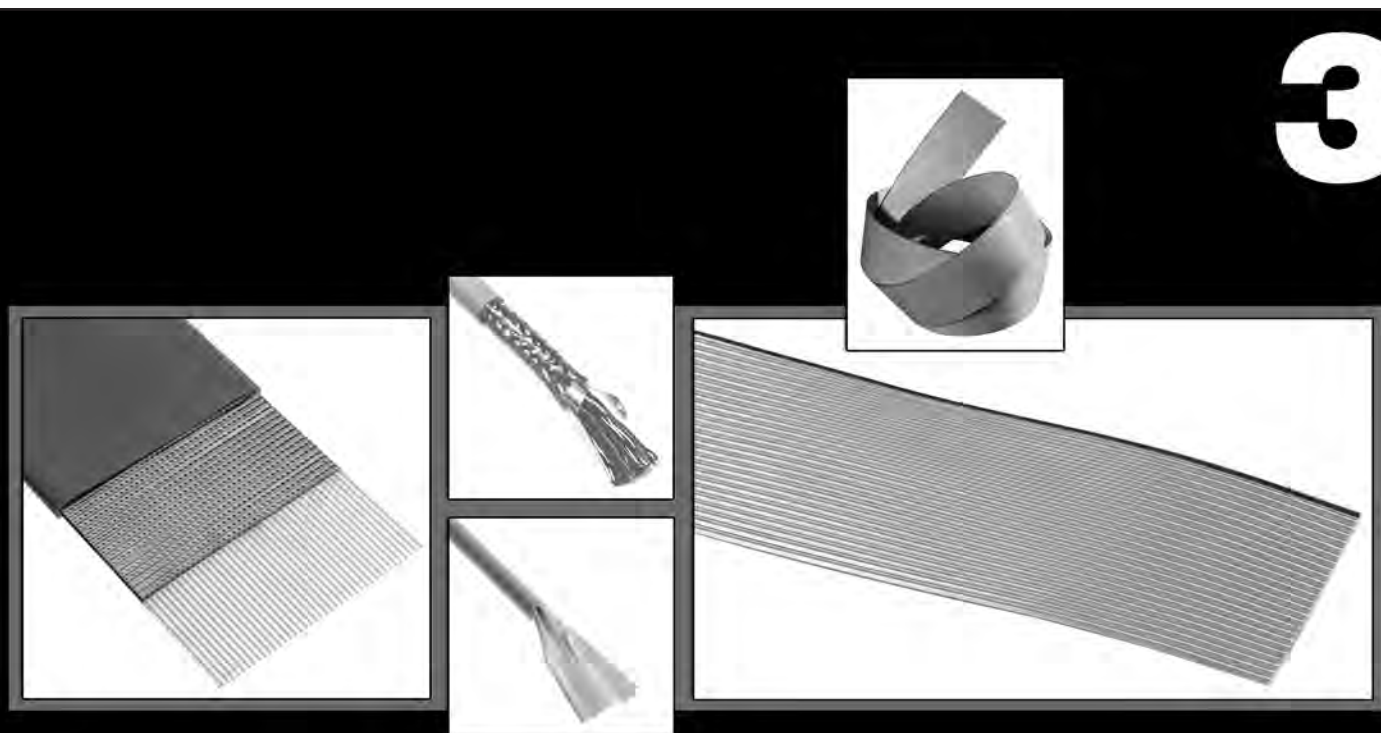
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Crimp Quality Standards Comparison and Trends

Continued from page 1

dards were. Larger companies with multiple plants, possibly in multiple countries are most susceptible to these kinds of challenges. Another consideration in these cases is language barriers. Different operators may take the same meas-

urement differently and come out with different results. So who is correct? These issues make data collection more difficult and as we all know, data collection can be a very time-consuming and inefficient process if not done correctly.

UL 486A-486B is probably the most widely used standard and covers termi-

nal and connector requirements for US, Canada and Mexico. The most specific standard for wire harness makers is the IPC/WHMA-A-620 standard, covering everything from crimping and soldering to lacing and tie wrapping. The IPC/WHMA-A-620 was a collaborative effort between IPC and the Wire Harness Manufacturer's Association. SAE AS7928, formerly MIL AS7928 and USCAR-21 are for military and automotive crimp connections, respectively. Both standards were created by the Society for Automotive Engineers. The most recent automotive specification is the VW 60330 which is the only process-oriented specification indicating how often testing should be done. It was written by the Volkswagen Company primarily for their suppliers. Each standard has their subtle differences. When you have some manufacturing companies who want products made to the UL spec and others who want products made to SAE specs, how do you keep track of the differences?

Much of the discussion to come will reference the automotive specifications. However, as quality standards get tighter, some of these standards may be adopted by other markets. I'm going to highlight a few of the differences between the tools and measurement techniques for crimp height and pull test and also mention micrograph (cross sectioning) equipment.

Crimp Height and Crimp Width

The only thing that all of the specifications have in common is that they all state that the terminal manufacturer's specifications for crimp height and crimp width must be used. Only the A-620 specification makes crimp height measurement optional. It is optional only when pull testing is done. Only the VW specification states that 5 samples must be tested for each set-up. A set-up is when the wire, terminal, terminal reel, or applicator tooling is changed.



Figure 1

The VW and A620 specifications states that for crimp height measurements, a micrometer with a point and a blade (Fig. 1) must be used. The reason is to eliminate the possibility for the flash to affect the measurement (Fig. 2). However, this method is not perfect either. If the measurement is not taken at the highest point of the crimp, the measurement may be incorrect.



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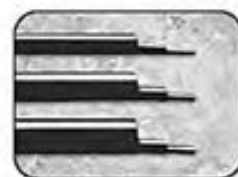
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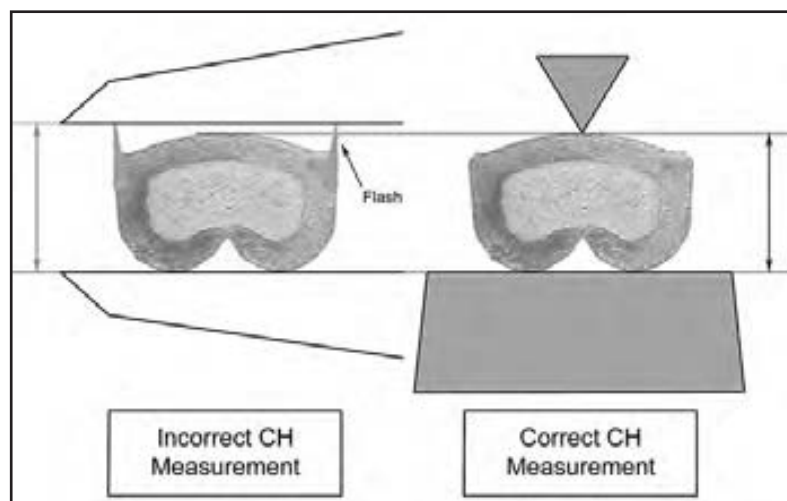


Figure 2

Crimp width is a bit of a challenge. Most companies don't measure crimp width because it is a fixed dimension in the tooling. The only specifications that really address it are VW and USCAR and they both use different terminology. They state that there are two crimp widths; one can be measured on the crimped terminal and the other cannot (Fig 3). The "Crimp Width" (VW) or "Tangent Width"

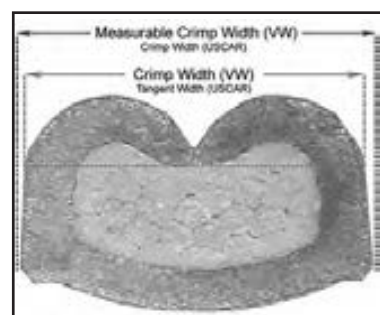


Figure 3

(USCAR) is the non-measurable crimp width. It is a dimension on the crimp tool at the top just where the rolled part goes to the straight sides of the tool. Technically it is between the tangents of the radii of the crimp die. The “Measurable Crimp Width” (VW) or the “Crimp Width” (USCAR) is measured at the widest point of the terminal. VW states that a 2-blade tool must be used to determine the measurable crimp width. The other specifications do not state requirements on tooling. Although I am mixing terminology from different specifications, for the purpose of this article I’m going to use the terms “Crimp Width” and “Measurable Crimp

Width” for clarity as shown in Figure 3.

Tolerances are sometimes an issue as well. Some of the terminal manufacturers indicate tolerances for crimp height but some don't. Some companies will use their own tolerances but some employees will apply them differently. Only USCAR and VW indicate tolerance specifications depending on the wire size. As you will see in the chart below, tolerances are the same but the corresponding wire sizes differ.

Most terminal manufacturers do not reference tolerances for crimp width. This can be challenging because as we all know, tooling wears. So what tolerance is used? The VW specification uses a $\pm 0.10\text{mm}$ for crimp width. The others do not address it.

Wire Size	Tolerances Conductor Crimp Height (CCH)
USCAR	
≤ 0.35mm ²	± 0.03mm
> 0.35mm ²	± 0.05mm
≥ 8.0mm ²	± 0.10mm
VW 60330	
0.22 - 0.5mm	± 0.03mm
0.5 - 2.5mm	± 0.05mm
> 2.5mm	± 0.10mm

Continued on page 36

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Aerospace Harness Testing

Crimp Quality Standards Comparison and Trends

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Pull Test

Pull test is discussed in all of the specifications and it is mandatory in all of them except the IPC/WHMA-A-620. The A-620 states that if crimp height meas-

urements are taken, then pull test is not required. The A-620 also specifies that any samples that are used for pull testing can not be used as finished goods.

Pull test rates vary between specifications as well. Pull rate is the rate at which the wire and the terminal are

pulled apart. It can be important because different values may be achieved if pull rates are not consistent. Usually, higher pull test values can be achieved with higher pull rates. The UL and VW specifications do not specify a rate, so manufacturers can use the fastest method available as long as there is no sudden jerking on the sample. USCAR specifies a rate between 50 - 250 mm per minute, but 100 mm per minute is preferred. The SAE AS7928 specifies a pull rate of 1" per minute.

When performing a pull test, most manufacturing companies do not remove the insulation crimp. However, the VW, UL and USCAR specifications require that the insulation crimp is opened up or rendered ineffective. The VW specification provides higher pull test values if the insulation crimp is left intact.

USCAR is challenging to adhere to in that it specifies that the device used for testing must be capable of a tolerance of $\pm 1\%$ of the measurement value. Most pull test device tolerances are stated with respect to their maximum pulling force. According to USCAR, a 24 AWG wire has a minimum pull force of 40 N (8.8 lbs). A tolerance of $\pm 1\%$ of the measurement value would be 0.4 N (0.09 lbs). To comply with USCAR you could not use the standard 110 lb (500 N) pull test devices unless it had an accuracy of better than 0.09%. Most

have accuracy of 0.5% or 0.25% of the maximum pull force, which is far from 0.09%. Stated another way, in order to achieve a tolerance of 0.4 N for the 24 AWG wire test, the pull tester could have a maximum pull force of 17.6 lbs (80 N) if the device had an accuracy of 0.5%. If the device had an accuracy of 0.25% the maximum would be 35.2 lbs (160 N). The smallest wire that could be tested on a 110 lb pull tester according to USCAR would be 12 AWG. Therefore, wire harness manufacturers that must comply to USCAR will either need pull test devices with extreme accuracy or they will need many devices for a complete range of wires. A wire range from 10 AWG to 22 AWG would require 5 different pull test devices.

Micrographs

Even with all of these standards, 25% of all electrical failures in a car (and possibly in other products as well) are due to bad crimps. Aside from simple mistakes made during the harness manufacturing process, terminals can go out of tolerance in the manufacturing process and frequently companies need to use terminals that are too large for the wire.

The following is an example (Fig 4) of a terminal that is rated for a wire range of 26 AWG to 20 AWG. The wire used is a 26 AWG and the crimp height and

Continued on page 38



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SABIC Innovative Plastics Announces ECO-01 Tubing

Through co-development efforts with SABIC Innovative Plastics, Japan's Nissei Eco Company Ltd.

has created a unique solution to significantly reduce the environmental impact of wire harness insulation. That solution is ECO-01 tubing, a wire insulation product made from SABIC Innovative Plastics' Flexible Noryl* resin. This high-tech resin is inherently flame retardant (FR) and free of environmentally harmful heavy metals. It also provides OEMs of home appliances and other products with high heat performance without expensive secondary operations. SABIC Innovative Plastics' continued investment in high-performance, green technologies is helping customers like Nissei Eco accelerate the creation of differentiated, environmentally progressive end products in an array of markets worldwide.

"SABIC Innovative Plastics' Flexible Noryl resin enabled us to develop a breakthrough tubing product to give

our company a significant competitive advantage," said Michio Inamura, chief executive officer, Nissei Eco. "The key to this success was replacing potentially harmful flame-retardant materials without sacrificing high performance or raising costs. Flexible Noryl resin met all of our requirements for the new ECO-01 product line and, thanks to this exceptional SABIC Innovative Plastics material, our customers are very pleased with what the new tubing has to offer."

"SABIC Innovative Plastics is intensely focused on developing advanced materials solutions with the environment in mind – from significantly reducing hazardous substances to using up-cycled and bio-

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Crimp Quality Standards Comparison and Trends

Continued from page 36

width is as specified by the manufacturer. The air gaps inside the crimp clearly indicate that the terminal is too big for the wire.

USCAR recognizes that not all wires are the same. A 0.5 mm² wire made to the SAE specification (0.508 mm² mini-

mum) is different from a 0.5 mm² made to the ISO specification (0.4647 mm² minimum). Because of issues such as this and the persistence of crimp quality problems, more and more companies, like VW in Europe and China, are integrating crimp cross section analysis into their production processes.

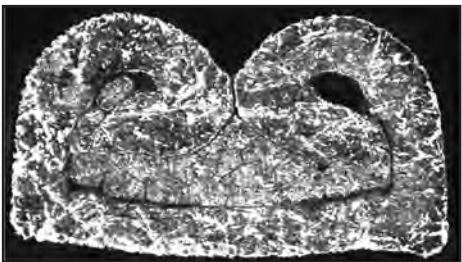


Figure 4

Micrograph systems, or crimp cross sectioning equipment, were typically only seen where applicator tooling was manufactured or in the labs of the large wire harness suppliers. They were large table units involving epoxies and acidic etching solutions. The systems typically cost \$50,000 or more and entire process was very time consuming. On the other

hand, this type of equipment is the only way to get a clear picture of the inside of the crimp (Fig 5).

New systems on the market are much more suited for use in the production process because the crimp analysis process is much faster since there are fewer steps. Most systems use an electrolytic staining process rather than acid etching. Acids require special training, gloves and eye protection as well as special procurement and waste processes, since acids are considered to be hazardous materials. The solutions in the new systems have a Ph value equal to that of water so they are much safer to use and no special procurement and waste processes are required. Finally, the new systems are far less expensive. Therefore, getting a comprehensive analysis on the entire crimp is faster, easier and less expensive.

Only the USCAR and the VW specifications discuss the use of micrograph systems. The USCAR specification identifies them as only diagnostic tools for resolving issues. The VW specification mandates their use depending on wire

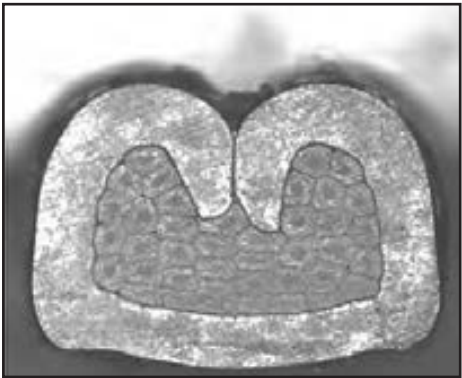


Figure 5

Continued on page 40

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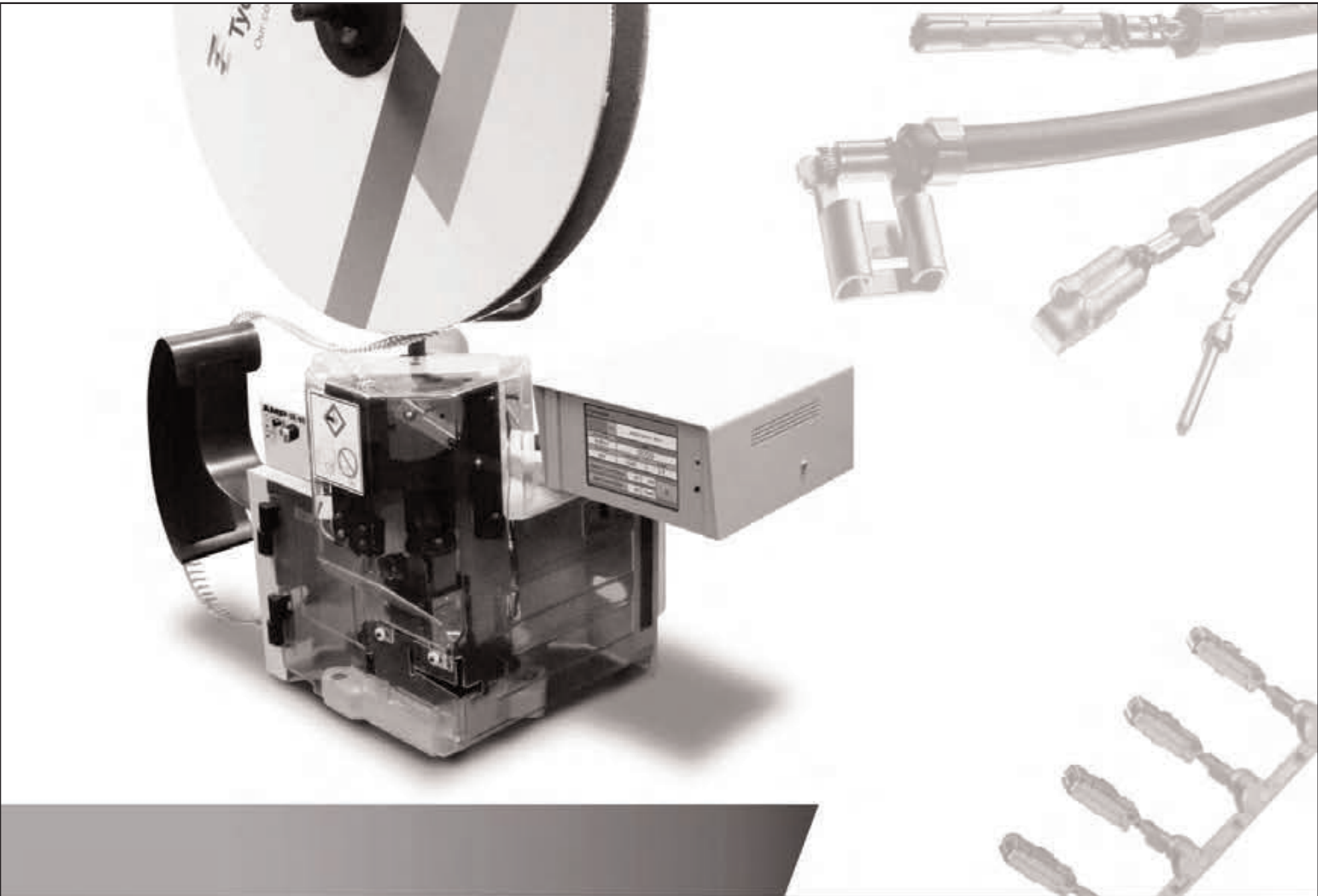
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Crimp Quality Standards Comparison and Trends

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size. More issues are seen in smaller wire sizes, so testing frequency is higher. The table below indicates the frequency requirements as stated in the VW specification.

Below is a sketch from the VW speci-

fication indicating all of the required measurements (Fig 6).

The crimp height (1) is the standard measurement. The crimp width (2) or the non-measurable crimp width can only be measured using a micrograph. The measurable crimp width (3) is simply taken at the widest point of the ter-

minal. The support angle (4) and support height (5) are indications of how centered the terminal is in the crimp and how strong the crimp will be over time. The more vertical the angle is and the larger the height is the stronger the crimp will be over time. The face end clearance (6) is an indication if the terminal is properly sized to the wire. If the terminal is too large, the face ends may touch or be too close to the bottom of the crimp. The distance between face ends (7) is also an indication of how centered the terminal is in the crimp. Burr height (8) and burr width (9) are indications of crimp anvil wear. Finally, base thickness (10) is an indication if the material has been over-crimped. The VW specification gives guidelines for each value indicating acceptable limits.

Micrographs are also very useful when verifying terminal bend angles (Fig 7) and cross area reduction. Both of which are very difficult to measure without a micrograph system.

Quality standards are getting more rigid each year. Much of the above discussion might not apply directly to your

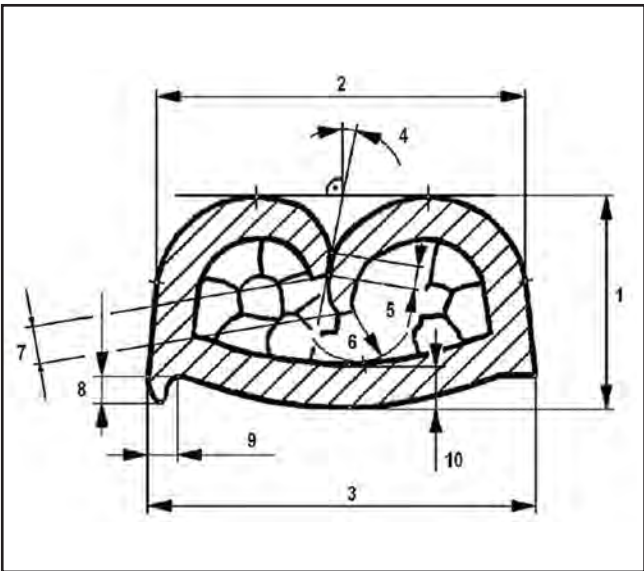


Figure 6

company right now. However, we've seen in the past that standards that begin in one industry eventually migrate to others. Therefore, hopefully this gives you some advanced warning about what might be needed in the future. The preceding discussion covered a very small percentage of the respective specifications, but hopefully this has given you a better understanding of the different specifications and how they may be applied in your business. For more information on the respective specifications, please go to:

- UL 486A/486B - www.ul.com
- USCAR 21 - www.uscar.org
- IPC/WHMA-A-620 - www.ipc.org
- SAE AS7928 - www.sae.org

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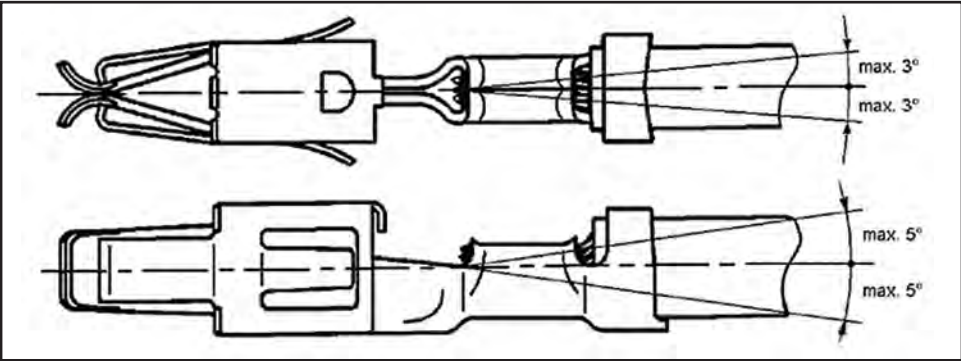


Figure 7

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NEWS PLUGS *continued*

Continued from page 37

source materials,” said Cathleen Hess, Noryl resin global product marketing director, SABIC Innovative Plastics. “Flexible Noryl resin is an excellent example of this. The material continues to break new ground by providing a unique environmental outcome for the most demanding wire and cable applications, demonstrating SABIC Innovative Plastics’ commitment to working alongside customers such as Nissei Eco for environmentally progressive solutions.”

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Further, Flexible Noryl resin surpasses other non-halogenated materials such as flame-retardant polyethylene (PE) in terms of affordability and processing ease. Because Flexible Noryl resin delivers high-temperature performance and can meet the requirements of UL105C, it does not require cross linking using electron beam radiation – a process that is



ECO-01 Tubing

necessary for flame-retardant PE. Cross linking adds time and cost, and also makes the material stiffer and harder to process.

The SABIC Innovative Plastics material also provides excellent flexibility with a high-quality surface finish.

ECO-01 tubing for wire harnesses has been specified by several home appliance manufacturers in Japan, while Nissei Eco is actively working to gain specifications around the globe.

For more information on SABIC Innovative Plastics’ Flexible Noryl products, please visit the company website at www.sabic-ip.com.

SABIC Innovative Plastics is a global supplier of engineering thermoplastics with a 75-year history of solutions that solve its customers’ most pressing challenges. Today, SABIC Innovative Plastics is a multi-billion-dollar company with operations in more than 35 countries and approximately 9,000 employees worldwide. The company’s extensive product portfolio includes thermoplastic resins, coatings, specialty compounds, film, and sheet. SABIC Innovative Plastics (www.sabic-ip.com) is a wholly owned subsidiary of Saudi Basic Industries Corporation (SABIC), one of the world’s top six petrochemicals manufacturers.

New BURNDYWELD® QIK-LITE Exothermic Ignition System

BURNDY®, a leading manufacturer and provider of connector solutions to the industrial, energy, construction, telecommunication, petrochemical, data center, and transportation industries, announces the introduction of the BURNDY-Weld® QIKLITE battery operated ignition system for exothermic connections. This new system uses innovative technology combined with traditional features and benefits unmatched in the industry.

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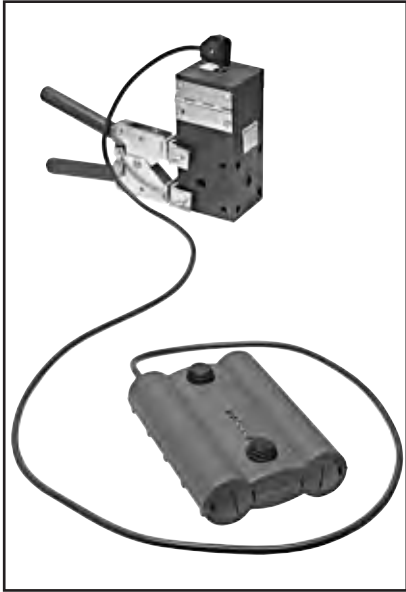
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battery life indicator, 6' igniter cord, and separate buttons for power and ignition. Also, no starting powder is used with this system so emissions are greatly reduced. QIK-LITE works with standard molds and weld metal, so contractors and installers can continue to use the same quality BURNDYWeld® products and have the option of using a traditional flint igniter or the new QIK-LITE system.

Another feature is the speed of ignition, with virtually no delay between depressing the "push to operate" button and ignition of the weld metal. This instant ignition feature offers quick reassurance to the installer, without the delay experienced with other options currently on the market.

BURNDY® continues to offer solutions to the grounding market and the BURNDYWeld® QIKLITE system is another valuable part of BURNDY's grounding platform of mechanical, compression, and exothermic options as well as a full line of accessory products.

For additional information, contact BURNDY® at 47 E. Industrial Park Drive, Manchester, NH 03109. Contact Customer Service at 1-800-346-4175. Visit website at www.BURNDY.com.

**Littelfuse Silicon
Protection Array (SPA™)
Sample Kits Available
Exclusively at Mouser**

Mouser Electronics, Inc., announced it is the only distributor to be stocking Littelfuse Silicon Protection Array (SPA™) Sample Kits.

Modern chipsets utilize nanometer processing technologies making them extremely susceptible to damage which necessitates the need for external protection. Silicon Protection Arrays™ (SPA) are specifically designed to protect sensitive electronic compo-

nents from ESD (Electrostatic Discharge), EFT (Electrical Fast Transients), and lightning induced transients. The Littelfuse SPA devices offer the lowest dynamic resistance during an ESD or any EOS (Electrical Over Stress) event which reduces clamping voltage levels far below that of competing technologies such as MLV, MOV, and polymer. The SPA portfolio offers a wide range of devices to suit the majority of applications available in the market today such as: USB 2.0/3.0, HDMI 1.3/1.4, DVI, 10/100/1000Mbps Ethernet, eSATA, 1394a/b, LVDS, audio, analog video, keypads/pushbuttons, and LCD/camera display interfaces.

Mouser is exclusively offering the SPA Sample Kits that include ten samples each of the 39 SPA devices. Additionally, each flexible notebook includes a product selection guide

and protection samples of 16 different common applications. Ultimately, the sample kit provides a cost-effective supply of various SPA devices for the convenience of design engineers.

Andy Kerr, Mouser Vice President of Passives & Circuit Protection, says the new SPA devices will solve numerous issues presented by today's ICs that have contact discharge levels down to $\pm 0.5\text{kV}$. Kerr says, "The Littelfuse Silicon Protection Arrays are an ideal solution for new ICs facing the threat of ESD damage. In addition, the SPA kits offered by Mouser will provide a cost-effective SPA supply and documentation for many suitable applications."

Continued on page 44

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The CT4 Coastelmatic hand tool holder is a device that uses air to activate spring retracted hand tools. The CT4 Coastelmatic is a great low cost alternative to automatic crimping, stripping, and cutting machines. The CT4 Coastelmatic can be set up to work crimpers, strippers and cutters. The patent pending tool holder in the applicator securely holds all tools in place, allowing the operator to use his hands freely. This new and improved cylinder delivers 10% more power through dual activation for tough jobs. Each unit is pre-assembled, tested and ready for use.

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NEWS PLUGS continued



Continued from page 43

"The Littelfuse line of Silicon Protection Arrays clearly delivers superior protection for today's demanding electronic applications," adds Paul Dickinson, Littelfuse Vice President & General Manager of the Semiconductor Products Business. "We are proud to partner with Mouser to offer devices that will address these challenging circuit protection issues for design engineers."

Mouser Electronics' website with interactive online catalog is updated daily and searches over 6.7 million products to locate over a 1.6 million part numbers available for easy online purchase. Plus, it houses downloadable data sheets, supplier-specific reference designs, application notes, technical design information and engineering tools.

Mouser Electronics, Inc. is an electronic component distributor, focused on the rapid introduction of new products and technologies to electronic design engineers. Mouser.com features more than 1.6 million products online from more than 400 manufacturers. Mouser publishes multiple catalogs per year providing designers with up-to-date

data on the components now available for the next generation of electronic devices. Mouser ships globally to over 270,000 customers in 170 countries from its 432,000 sq. ft. state-of-the-art facility in Mansfield, Texas. For more information, visit <http://www.mouser.com>.

Littelfuse is a leader in circuit protection, offering a broad portfolio of circuit protection products and solutions. Backed by industry-leading technical support, design and manufacturing expertise Littelfuse products are vital components in virtually every product that uses electrical energy, including portable and consumer electronics, automobiles, industrial equipment and telecom/datacom circuits. In addition to its Chicago, Illinois, world headquarters, Littelfuse has over 20 sales, distribution, manufacturing and engineering facilities in the Americas, Europe and Asia. Technologies offered by Littelfuse include Fuses;



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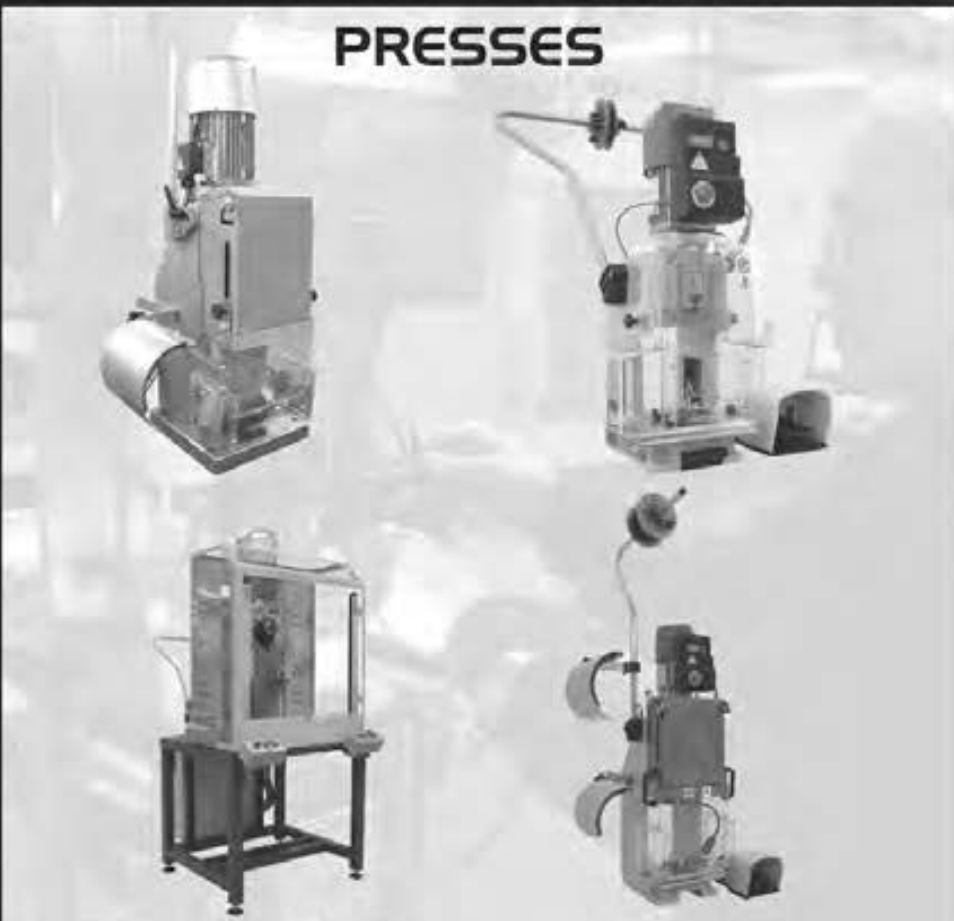
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Established in 1976 with the aim of supplying the wire harness industry with the best crimping equipment available, in less than 30 years Mecal has reached and kept a respected position at the top of its market. Their products are extensively used by the automotive, communication and IT industry, and wherever a high quality connection is called for. Situated in the middle of the most industrially developed part of Italy, Mecal operates out of its fully owned 54,000 sq. ft. plant, employing 100 skilled and motivated young people and has a very modern and rational production structure.

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Established in 1945, Starn Tool soon became a leader in supplying the automotive industry with progressive stamping dies and spare parts along with the building and assembly of applicator bodies for one of the world's largest terminal manufacturers. It was this experience that Mecal was looking for to form a partnership in the United States. Through this partnership, Starn Tool and Mecal by Starn are providing world class applicators and spare tooling for the wire harness industry.

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NEWS PLUGS continued



Alpha Wire Announces New Master Catalog on the Complete Alpha Wire Product Line

Alpha Wire is proud to announce the release of its new Master Catalog containing the full Alpha product portfolio. The new Master Catalog features all Alpha Wire products, including Xtra-Guard® Performance Cable, Manhattan™ Electrical Cable, Alpha Wire Industrial Series Cable, Hook-up wire, Dearborn® Marine Cable, and FIT® Shrink Tubing & Wire Management products.

“With this release, finding all the Alpha Wire products you need will be easier and faster than ever,” says Mike Dugar, Director of Marketing for Alpha Wire. “Plus, our Technical Information section is improved to provide valuable resources for engineers and sales people from all industries.”

The Master Catalog includes unique Cable Finder Guides that enable users to search for a product based on its physical and performance characteristics, as well as by industrial ratings, application, or competitive product cross-reference. Each applicable product page also contains FIT® Tubing Recommendations for applications requiring wire management products.

To view, download, or order the Alpha Wire Master Catalog, visit www.alphawire.com or use this direct link: www.alpha-wire.com/OnlineTools/MasterCatalog.aspx

Eraser Offers Model WC601A Automatic Wire and Flexible Tubing Cutter

Eraser’s Model WC601A Automatic Wire & Flexible Tubing Cutter the ultimate in bench top, automated processing. The unit easily and accurately cuts wire, tubings, sleeveings and more to the programmed length and number of pieces. Nine variable feed rates allow the operator the flexibility to choose the correct rate for a given material to optimize production rate, repeatability and accuracy of the cut length. The unit utilizes an adjustable self-centering dual driven belt feed, coupled with an air-activated cut-off blade.



Eraser Model WC601A Automatic Wire and Flexible Tubing Cutter

Programming of the unit is simple. A batching feature allows all variables for frequently run jobs to be pre-programmed. Up to 99 batches may be programmed. A kitting feature allows for multiple pieces of different lengths to be cut within a batch. Up to 10 kits can be programmed.

- Specifications include:
- Maximum Cut Length: 99,999" (99,999cm)

- Minimum Cut Length: 0.01" (0.2mm)
- Maximum Material Size: 3/8" OD (9.5mmø)
- Maximum Solid Copper Content (wire) Stranded: 10AWG (2.59mmø)
- Solid: 12AWG (2.06mmø)
- Tolerances:
 - At cut lengths of under 2" (51mm) on most materials, the tolerance is ±0.01"(.25mm).
 - All other cut length tolerances are 1%

- or better dependent on material and feed.
- Programmable length compensation of ±99% is built into the unit to accommodate unusual materials.
 - Batching: Up to 99 programmable batches
 - Kitting: Up to 10 programmable kits
 - Counter: 0-999,999
 - Power: 110V 60Hz and up to 90 P.S.I.

Continued on page 48

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NEWS PLUGS *continued*

Continued from page 43

air supply

- Size: 14" x 13" x 8-3/4" (356mm x 330mm x 222mm)

- Weight: 24lbs. (10.9Kg)

The Eraser Company, Inc., celebrating its 99th anniversary in business, manufactures a wide range of industrial products including wire, cable and tubing cutters, wire and cable strippers, wire twisters, wire brush wheels, dereelers, infrared heating equipment, measuring tools, and fybRglass® erasers. The company is ISO 9001:2000 certified. The company offers Free E.S.P. (Eraser Sample Program). Send a 10-20 foot sample of your material and

Eraser will recommend the best solution for your processing needs from its line of more than 200 products. For unique processing needs, Eraser will custom design a solution for you. For more information on Eraser's entire product line visit www.eraser.com or call 315-454-3237.

New InfiniTwist Cables from Tyco Electronics Offer a High-Speed Solution for Parallel-Pair Cable Designs

Tyco Electronics launches a new family of Madison Cable brand InfiniTwist cables designed to outperform parallel-pair cable products currently available in the market in bend radius, flexibility and overall mechanical reliability.

Utilizing a twisted shielded-pair design, InfiniTwist cables improve cable management in high-density systems through a tighter bend radius that is less than 2.5X cable diameter -- tested in accordance to SFF 8417 Multi Conductor



Tyco Electronics InfiniTwist Cables

Cable Flex Cycle Test Procedure. The cables exhibit virtually no pistoning of conductors or pairs -- reducing commonly-known parallel-pair design termination issues. The twisted-pair feature increases flexibility and mechanical reliability over parallel pair, decreases time delay skew and improves mode conversion.

Available in constructions of 1 through 36 pairs and above, InfiniTwist cables utilize conductor sizes of 24 AWG through 32 AWG to meet the demands of multiple

interconnect lengths. The cables can be manufactured in both 85 and 100 Ohm impedance and support transmission speeds up to 16 GHz and beyond.

The high-speed cables are well-suited for InfiniBand standard (SDR, DDR, QDR, and FDR - 1X, 4X, 12X); 10G/40G/100G Ethernet standard (1X, 4X, 10X); SAS 6; and 12 Gb/s, SFP+, QSFP+, CXP, CR4, CR10, 16 Gb/s Fibre Channel standard applications -- and other custom applications as specified by customer requests.

For more information on new Madison Cable brand InfiniTwist cables contact Tyco Electronics at 877-623-4766 or (1) 508-752-2884, or visit www.tycoelectronics.com/help.

Thomas & Betts Introduces Its New Color-Keyed® HEX-FLEX™ Crimp

The new Color-Keyed® HEX-FLEX™ crimping dies from Thomas & Betts provide an inspectable, high-performance crimp on flex-conductor cables. The dies create a unique hex-style crimp on the top of the connector, and an indent crimp in the bottom for superior pull-out resistance.



Color-Keyed® HEX-FLEX™ Crimping Die

Designed for use with virtually all types of flexible conductors, the new HEX-FLEX dies are color-coded for easy matching with Color-Keyed lugs and splices to help eliminate costly errors. It creates a UL Listed, CSA Certified connection when used on Color-Keyed compression connectors.

The dies are made from high-carbon tool steel with black oxide plating for added durability, corrosion resistance and long service life. They will fit most existing 6- and 14-ton T&B compression tools, as well as 15-ton tools with a 15500-TB adapter (no additional tools required).

"The increasing popularity of flex cable has created many challenges for installers," said Matt Willard, Thomas & Betts product manager. "By combining the hex-style and the indent style crimps together, you get the best of both worlds, the ability to easily inspect crimp connections and the pullout strength required in the most demanding environments."

For more information visit www.tnb.com, or contact your Thomas & Betts sales representative by calling (800) 816-7809.

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The Tape-Terminal Crimp Module and Tape Terminal Press from Molex will reduce tooling investments, reduce setup times and allow you more production flexibility.



The **TM-4000™ Universal Crimp Press** is the only industry-standard, bench-top press on the market that terminates large lug products on Mylar tape up to 4 AWG, resulting in lower overall applied costs. The TM-4000™ has electrical requirements of 240 AC 50/60Hz.

Features and Benefits of the TM-4000™ Universal Crimp Press Include:

- Provides 3.5 tons (31 kN) of crimp force for tape-mounted terminals up to 4 AWG.
- Accepts Molex FineAdjust™ and Mini-Mac™ applicators with side and rear feeds; accepts most industry-standard applicators.
- Can be used with Molex Tape Module (64016-2000).
- Meets OSHA safety and noise requirements and is CE approved.
- Has two safety interlock switches attached to the guard.

The **Tape-Terminal Crimp Module** from Molex efficiently crimps terminals to wires from 4 to 30 AWG with minimal setup adjustments and achieves optimal cycle rates for mid-to-high volume, semi-automatic operations.

Features and Benefits of the Tape Terminal Crimp Module Include:

- Quick-change modular tooling accepts all existing ATP-201 and ATP-301 die sets.
- Used in Molex TM-3000™ and TM-4000™ presses, which accept Molex applicators and most industry standard applicators.
- Independent adjustment of insulation crimp height provides flexibility for various wire insulation thicknesses.
- Quick tool changeover from die set to die set.

Heilind Electronics is the preferred stocking distributor for the new TM-4000™ Universal Crimp Press. Call for immediate shipment.

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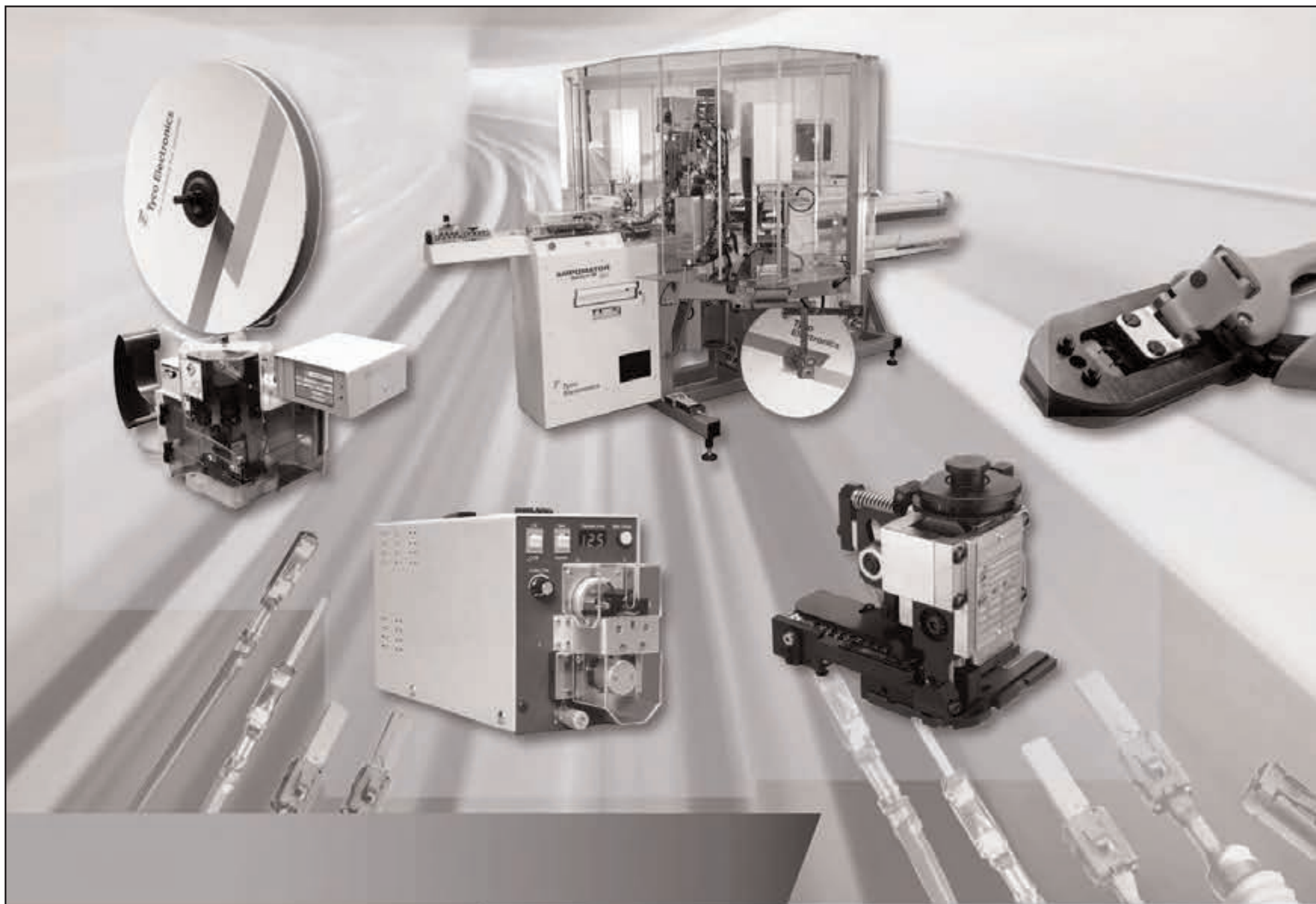
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Bobo Engineering was ounded in 1977. Our goal is to provide customers with “defect-free” products at a competitive price in a timely manner. The result is a company with over 30 years of experience in the wiring harness/cable assembly business. Bobo Engineering is Woman-Owned, Small Business and Hubzone Certified.

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Ph: 915-543-3212, Fx 915-543-3213
E-mail: csmail@cesar-scott.com
Web: www.cesar-scott.com

Cesar-Scott, Inc. is a sales and marketing company. It was founded in 1988. The company is divided into three business units; manufacturing, distribution and representation. Cesar-Scott manufactures wire harnesses and cable assemblies for the appliance and automotive industries. Cesar-Scott sells and distributes electronic components, wire, and heat shrink tubing. We are a minority enterprise and members of the Greater El Paso Chamber of Commerce.

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Control Cable is a small, veteran owned business with over 30 years experience in wire harnesses, cable assemblies and structured wiring systems. Capabilities include custom integration of assemblies into customer's products. We provide solutions, reliability and cost effective innovations to OEMs, LAN/WAN users and the premise wiring markets.

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Founded in 1977, Electrex is dedicated to providing value added electrical components and engineering services to customers desiring integrity, innovation and excellence in a partnership relationship. Some of our services include: Wire Stamping, Ultrasonic Welding, Braiding, Electrical Testing, Engineering, Wiring Harnesses (*Simple & Complex*), Battery Cables and Panels.

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E-mail: jennifer@evergreensales.com
Web: www.evergreensales.com

Evergreen Sales is a manufacturer specializing in wire processing and insert molding of wire and cable assemblies. We automatically cut, strip, solder, tin, terminate, connectors, etc. Our facility is cost effective and GMP (medical) compliant. Our goal is quality assemblies shipped on time.

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RPC Manufacturing Solutions in Denver, CO. is contract manufacturer specializing in box-builds, panel assembly, wire harnesses, custom cables, component modifications, power cords and electro-mechanical assembly services. RPC serves OEM manufacturers in a variety of industries including: Aerospace, Medical Equipment, Gaming, Telecom, High-Tech, Automotive, Agricultural Equipment, Measurement Instruments, Control Devices and Electrical Equipment Manufacturers of all types. RPC complies with standards for IPC/WHMA A-620, ISO & FDA in addition to being UL registered and qualified for NASA ground support projects.

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TIM-CO/CAL-F has served the Aerospace, Defense, Computer, Telecommunications and Industrial industries since 1960 with on-time delivery. We are ISO 9001:2000 compliant. TIM-CO is an authorized value-added distributor of electronic and electrical connectors (commercial and military), passive and electro mechanical components. CAL-RF manufacturer’s and

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Thermtrol MGI Global LLC is a TS16949 Certified manufacturer of custom wire harness & cable assemblies with notable competencies in insert/over molding. The company is currently serving that automotive, agricultural equipment and appliance industries among others. For high volume/high labor content manufacturing, the company features the services of its six-year old wholly owned sister company, Thermtrol (VSIP) Co. of HCMC, Vietnam. Thermtrol is genuinely interested to explore strategic opportunities with industry partners.

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Web: www.wmico.com

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E-mail: Sales@SonobondUltrasonics.com
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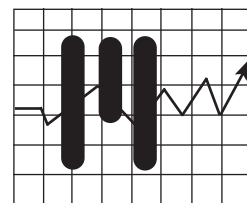
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609	Hydraulic Crimping Head for 1/0 AWG - 600 MCM, dies sold separately	\$1,470
610	Hydraulic Crimping Head for 8 - 2 AWG, dies sold separately	\$1,417
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YA1	Pneumatic Crimp Tool for wire ranges 26-10 AWG, dies sold separately	\$203
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	AD200 for straight insulated 26-22 AWG	\$388
	AD200F for flared insulated 26-222 AWG	\$443
	AD201 for straight insulated 22-16 AWG	\$300
	AD201F for flared insulated 22-16 AWG	\$300
	AD202F for flared insulated 26-14 AWG	\$290
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	AD302 for closed end connectors 16-14 AWG	\$187
	AD303 for closed end connectors 12-10 AWG	\$169
	AD304 for closed end connectors 8 AWG	\$319
YA2	Pneumatic Crimp Tool for wire ranges 26-10 AWG. dies sold separately	\$522
Dies for YA2		
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	AD602 for insulated 22-16 AWG	\$221
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	AD911 for insulated 22-16 AWG	\$433
	AD911F for insulated disconnects 22-16 AWG	\$479
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YHM228	for non insulated 22-8 AWG	\$27
YHM61	for non insulated 22-8 AWG	\$15
YHM88	for non insulated 16-6 AWG	\$18
YHT2210	for non insulated 22-10 AWG	\$133
YHT2216P	for non insulated locking spades 22-16 AWG	\$115
YHT2622	for non insulated 26-22 AWG	\$75
YHT8S	for non insulated 8 AWG	\$123
YNG2214A	for insulated flag disconnects 22-14 AWG	\$39
YN12214	for insulated 22-14 AWG	\$235
YNM112	for insulated 22-14 AWG	\$59
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YNM2210D	for insulated w/support sleeve, 22-10 AWG	\$25
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CALENDAR OF EVENTS

Productronica India
September 7-10, 2010
Bangalore International Exhibition
Karnataka, India
Productronica India is the innovative platform for production technologies which are experiencing strongly increasing demand due to the fact that India has emerged as an important destination for electronics manufacturing. The product spectrum is optimally geared to the market requirements. Together with electronica India, the entire value-added chain of the electronics industry is presented. Visit www.electronica-india.com for more information.

NECA Convention & Trade Show
September 7-10, 2010
Mandalay Bay Resort & Casino
Las Vegas, Nevada
The NECA Show is the premier expo for the electrical, power and cabling industry. At the NECA Show, electrical professionals can view the latest innovations in tools, system controls, software and vehicles, plus learn about the business services they rely on. The NECA Show is the once a year opportunity for large and small electrical contractors to meet the manufacturers, utilities, inventors, distributors, consultants and engineers that make their companies work. See www.neca.org for more details.

Avionics, Fiber-Optics and Photonics Conference 2010
September 21-23, 2010
Denver Marriott Tech Center
Denver, Colorado
The aerospace industry has made great strides in recent years deploying fiber optics and photonics technology on commercial and military platforms. This trend will continue to grow as avionics fiber optic system architectures, networking schemes, and components evolve and mature. In parallel with data and video transmission, photonics technology for analog/RF, flight control, free-space communication, and vehicle monitoring applications will have an increasing role in future aerospace platforms. This application-oriented conference will provide a common international forum for leaders, researchers, engineers, technicians, logisticians, manufacturers, and instructors to convene and discuss all aspects of severe environment fiber optic component, systems, reliability, maintainability, producibility and supportability technology, and its future direction. For information see www.photonicsconferences.org.

Assembly Technology Expo
September 28-30, 2010
Donald E Stephens Convention Center
Rosemont (Chicago), Illinois
Stay at the forefront and remain competitive with the latest technical training for manufacturing professionals. The ATE expo Conference gives you the knowledge you need to make your assembly process work better from design to end-of-line packaging. Attending Assembly Technology Expo helps you keep pace with global competition with innovative products and ideas that make your process faster, better, and less costly. For further information visit www.atexpo.com.

Electrical Manufacturing and Coil Winding Expo 2010
October 18-20, 2010
Gaylord Convention Center
Dallas, Texas
A technical conference with presentations from Industry Leaders related to the design and manufacturing technologies of transformers, permanent magnets, AC/DC motors, electrical coils and components. This new 6 in 1 event will attract hundreds of professionals from the electrical manufacturing industry. For further information visit www.emcw.org.

National Marine Electronics Association Expo
October 29 - November 1, 2010
Sheraton Seattle
Seattle, Washington
The NMEA brings to life the products and services of the marine electronics industry. If your products are used in the marine electronics industry, the NMEA International Conference and Expo is the ideal opportunity to position your company as a leader and promote the benefits and solutions you provide. Register at www.nmea.org.

Mexitronica
October 19-21, 2010
Expo Guadalajara Centro
Guadalajara, Jalisco, Mexico
National Electronics Manufacturing Conference and Expo, Mexitronica, is Mexico's number one source for information on products, suppliers, service providers, and new technologies for the electronics and precision manufacturing industries. For details see www.mexitronica.com.

Electronica
October 9 - November 12, 2010
New Munich Trade Fair Center
Munich, Germany
With a constantly high number of exhibitors and visitors, electronica 2010 sends out some positive signals to the international electronics industry. The trade fair is about to attract around 2800 exhibitors and approximately 73,000 visitors. See www.electronica.de to register.

Electronics West
February 8-10, 2011
Anaheim Convention Center
Anaheim, California
See all aspects of electronics manufacturing, including components, subassemblies, software, contract services, assembly, test and inspection products. Get input on your upcoming project from hundreds of experienced companies, all in one day! You can develop supplier alliances, technology licensing, partnerships and joint ventures to expand your business. The NEW Innovation Briefs Theatre features 30-40 minutes sessions on current manufacturing topics. Delivered by industry experts from the world's leading OEM suppliers, you can find them right on the show floor, for FREE. Our schedule of speakers and topics will be finalized in the near future. For further information visit www.ElectronicsWestShow.com.

Wiring Harness Manufacturer's Conference (WHMA)
March 2-4, 2011
Westin San Diego
San Diego, California
Once a year WHMA sponsors a conference that offers members the opportunity to participate in committee sessions, attend educational programs and check out the industry's latest at the suppliers' technology exhibits. For further information visit www.whma.org or call (952) 253-6085.

IPC/APEX Expo 2011
April 12-14, 2011
Mandalay Bay Resort & Casino
Las Vegas, Nevada
The largest show for the electronics interconnect industry. You will see everyone from designers and printed circuit board companies to electronics manufacturing service companies to OEMs to suppliers. This even includes a premier comprehensive technical conference, professional development courses and networking activities specifically for designers, engineers, manufacturing personnel, managers and senior officers. Contact MaryMacKinnon@ipc.org for details.

National Electrical Wire Processing Technology Expo
April 12-14, 2011
Frontier Airlines Center
Milwaukee, Wisconsin
The National Electrical Wire Processing Technology Expo features new products and services for electronic cable assemblies, cord sets, wiring harnesses and other products within the wire processing industry. Meet over 100 world-class suppliers and service companies in the wire and cable processing industry. Discover the secrets to solve your wire processing problems. Visit www.expoproductions.com for exhibitor and attendee information.

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marilynmagowan@yahoo.com

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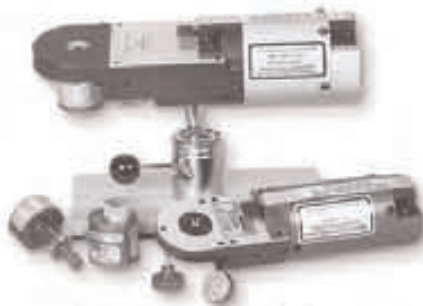
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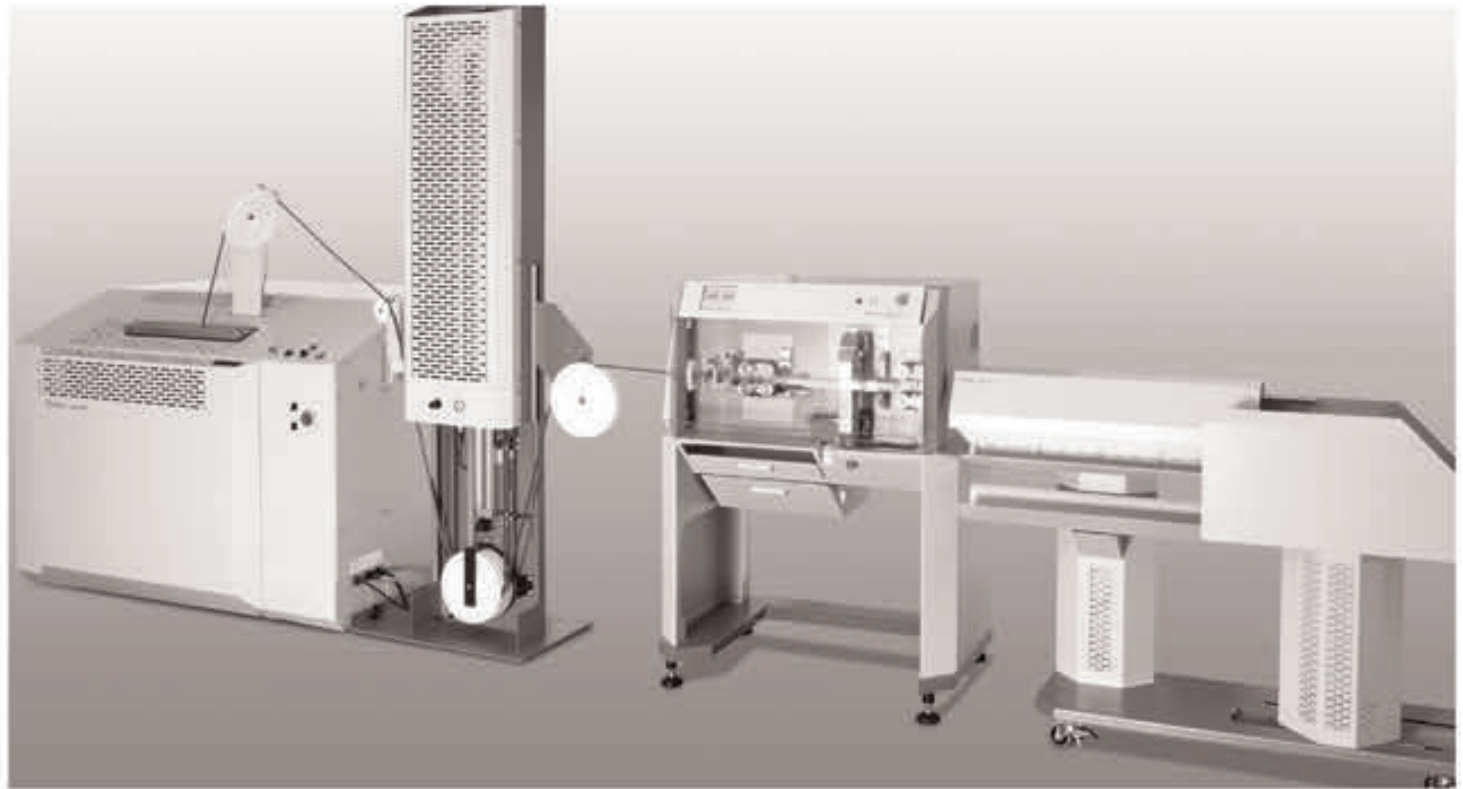
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